APPENDIX F - AGRICULTURE

FARMING

Appendix F-1

SURFACE IRRIGATION SYSTEMS

DESIGN CONSIDERATIONS

A well designed surface irrigation system should uniformly apply water to a crop root zone before soil water is depleted beyond certain limits. The available stream size, length of run, and grade of the land units should be combined to meet the optimum timing and amount of irrigation water determined. Flexibility and positive water control should be incorporated into the system, since the optimum timing and amount of irrigations will not always mean replenishing the root zone reservoir upon reaching a fixed depletion. The system should achieve the desired results without excessive labor inputs, water waste, erosion and inconvenience to the farming operations.

Preliminary design considerations should include an evaluation of general topography, soils, planned cropping programs, farming practices, and available financing. This should allow the selection of one or more types of surface irrigation systems including corrugations, furrows, low pressure sprinklers, border checks, basins, contour checks or ditches, or wild flooding. Selection and design should be based on detailed information regarding water, soils and topography, crops, and other factors. **The assistance of a qualified professional may be necessary.**

Water - The design should be based on the cost, amount, and availability of water allocated to the area under consideration with special importance on the water supply during periods of peak crop water use.

Soils and Topography - Soils data required include depth of potential root zone, water-holding capacity, available water in the root zone reservoir, chemical analyses, variations in soil type and texture, intake characteristics, leaching requirement, and drainage capacity. The topographic data necessary includes slope of the land, degree of land leveling or smoothing, point of water delivery, and surface drainage potential.

Crops - The design should be based on specific crop data for existing and planned cropping programs. This includes rooting depths, growth and water use characteristics, peak water use requirements, field restrictions required to grow and harvest the crop, and germination requirements.

Other Factors - The availability and cost of labor and energy inputs, financial resources required, and the required operation and maintenance programs are additional design considerations.

Materials Used

A wide variety of materials is available for the components of surface irrigation systems. Where conditions dictate, the conveyance and distribution facilities may need to be constructed from something other than soil.

Open conveyance and distribution facilities can be lined with concrete, plastic, asphalt, soil cement, or bentonite clay to minimize seepage and erosion. Special attention must be given to the required water surface elevations, hydraulic forces on the lining from inside and outside the channel, adequate freeboard, channel velocities, and the degree of wetting and drying encountered in the channel.

Pipelines are frequently used to convey and distribute water for surface irrigation systems. Common materials include PVC, aluminum, concrete, and cement. Selection of a pipe material will usually depend on availability, cost, design requirements, and grower's preference.

Many alternatives exist for the actual distribution of water. Included are soil notches, concrete notches, spiles, siphon tubes, gated pipe, and risers with alfalfa valves on pipelines. The final design should also include an evaluation and incorporation of automation where appropriate.

Final Considerations

The design of surface irrigation systems following selection of a system type should be based on the predicted advance and recession curves for a given land unit. Consideration should be given to achieving a uniform irrigation without excessive runoff or deep percolation losses. The use of tailwater recovery systems may allow higher application rates and thus shorten advance times to achieve uniform irrigations since the runoff water can be reused. Irrigation streams should be sized to be nonerosive.

The final surface irrigation system design should provide an integral combination of land grading and smoothing, water measurement and control structures, conveyance facilities, surface distribution facilities, and provisions for removal and/or reuse of drainage water. For example, a surface irrigation system comprised of a buried plastic conveyance pipeline, alfalfa valves, a gated pipe distribution system with 1/8 mile runs, proper stream size, and a tailwater recovery system will achieve high irrigation efficiencies.

DESIGN SPECIFICATION

Surface irrigation systems should be designed by qualified professionals. Criteria and specifications for the actual design can be found in the following references:

Hagan, R. M., Haise H. R., and Edminister, T. W., 1967, **Irrigation of Agricultural Lands.** Number 11 in the series, Agronomy. American Society of Agronomy, Madison, Wisconsin.

Soil Conservation Service. **SCC National Engineering Handbook, Section 15.** United States Department of Agriculture, Washington, D.C.

Soil Conservation Service. **Irrigation Guide.** United States Department of Agriculture.

Appendix F-2

WATER CONTROL STRUCTURES

DESIGN CONSIDERATIONS

Surface irrigation requires control of the irrigation stream to reach all lands to be watered. Control structures are necessary in the conveyance system to drop water to a lower elevation and to divide or divert the flow to the appropriate farm ditch. The structure must also protect the channel sides and bottom from erosion at the structure site. The dimensions of the structure will depend on its use, water flow, and soil erodability. All structures should be installed plumb and level and at the proper elevation relative to the channel and desired water level. The materials used for construction will depend on cost, availability, ease of installation, and desired life. Typical materials are concrete, wood and metal.

The structure required will depend upon the needed function: drop, distribution, or application.

Drop Structures

Drop structures are used where an elevation change is necessary or where the slope of a ditch creates an erosive velocity. There are two general types of drops: Open Drop and Pipe Drop.

Open Drop: The open drop structure usually consists of an upstream cutoff wall, a drop chute, and a downstream cutoff wall. The downstream cutoff wall should include a splash section extending above the chute bottom creating a stilling basin for energy dissipation. The top of the splash section should be at the elevation of the ditch bottom. The upstream cutoff wall can be fitted with splash boards to double as a check. A side chute can be added for division or diversion of the flow.

Pipe Drop: A pipe drop is used when the change in elevation is at a roadway or other embankment. It consists of an inlet box and a pipe chute extending vertically from the inlet box and then horizontally under the embankment to the receiving ditch.

Distribution Structures

Distribution structures are used for division or diversion of water in a ditch system. Typical distribution structures are headgates, division boxes, and checks.

Headgates: Used to divert water into the farm distribution system. Headgates can be a headwall and pipe outlet or open structure with a shutoff gate and are often calibrated as a measuring device. Headgates should have cutoff walls. A closed pump box, constructed with a bottom and outlet chutes, is a special adaption of a division box.

Checks: Used to control the upstream water level in a head ditch to divert the water from the ditch. Permanent checks can be a single headwall where nonerodable soils exist or with a chute where erosion may endanger the structure. These are usually equipped for flashboards. Canvas or plastic sheets can be used as a temporary check.

Application Structures

Application structures are used for controlling the flow of water from the head ditch onto the field. Typical application structures are turnouts, siphons, and gated pipe.

Turnouts: Concrete, metal or wooden boxes and concrete or metal pipes through the ditch bank. Boxes should be equipped for flashboards or with a gate. An exception would be spiles which operate by overpouring with the rise of the water in the ditch. The elevation of the pipes, especially spiles, in the ditch bank is critical.

Siphons: Plastic or aluminum curved pipes which deliver water over the ditch bank to the field. Downstream end of siphon must be lower than the level of the water in the ditch. Good for use with temporary ditches. Also, permanent ditches remain unobstructed for cleaning.

Gated Pipe: Portable pipe (rigid or flexible) with many small gates or outlets through which water is applied to the field. Can be used in place of, or in conjunction with, the head ditch.

DESIGN SPECIFICATIONS

The design and construction specifications should be prepared by a qualified professional, experienced in irrigation system layout and design. The following reference is a source of design specifications for small water control structures. Specifications and drawings can also be obtained from Soil Conservation Service offices.

Aisenrey, A.J., J., et al, 1974. **Design of Small Canal Structures**. United States Department of Interior, Bureau of Reclamation, Denver, Colorado

Appendix F-3

WATER MEASURING DEVICES

DESIGN CONSIDERATIONS

The measurement of irrigation water allows the irrigator to become more efficient by knowing how much he is applying. Measurement is also important to ensure proper distribution according to water rights, shares, or quantity ordered, and to maintain efficient performance of wells and pumps.

The type of measuring device used will be determined by one or more of the following conditions:

Ease of Use
Desired Accuracy
Type of Flow (open channel or pipe)
Frequency of Measurements Desired (structure permanency)
General Size of Flow
Economics

Common types of measuring devices are:

1. Collecting Water in a Container of Known Volume: For a measured period of time. Used for small flows through spiles from head ditch and from sprinkler nozzles. Good accuracy. Inconvenient for frequent measurements. Economical and easy to use.

2. Commercial Water Meters: Used in a closed pipe system or a constantly submerged pipe outlet. Usually has a dial showing accumulated volume of water. Good accuracy. Constant reading. Low to moderate flows.

3. Timing a Floating Object: Or tracer of dye or salts as it floats through a measured channel distance. Easy and economical. Relatively low accuracy. Channel cross section should be uniform. Moderate to large flows.

4. Current Meter: Used in open channels. Measures velocity through known cross-sections. Reasonable accuracy possible. Moderate to large flows. Inconvenient for frequent measurements.

5. Pipe Trajectory: Used on open discharges from pipes. Easy and economical. Moderate accuracy. Moderate to large flows.

6. Pitot Tube: Used primarily for flow in pipes. Good accuracy. Inconvenient for frequent measurements. Economical (after original equipment purchase).

7. Weirs: Used in open channels. Usually permanent installation. Good accuracy and easy to use. Low to large flows. Economical. Critical installation requirements.

8. Parshall Flume: Used in open channels. Permanent installation. Good accuracy with low to large flows. Easy to use. Critical installation requirements.

9. Orifices: Can be free flowing or submerged in open channels. Good accuracy with low to moderate flows. Easy to use and economical.

10. Commercial or Farm-Constructed Headgates: Must be calibrated. Used in open channels. Moderate accuracy. Dual use. Permanent installation. Low to large flows.

DESIGN SPECIFICATIONS

The design and construction specifications should be prepared by a qualified professional experienced in hydraulics. The following references are sources for design specifications and flow charts:

Bureau of Reclamation, 1975. **Water Measurement Manual,** United States Department of Interior, Washington, D.C.

Scott, Vern H. and Clyde E. Houston, 1959. **Measuring Irrigation Water.** Circular 473, California Agricultural Experiment Station, University of California, Davis.

Soil Conservation Service, 1962. **SCS National Engineering Handbook, Section 15, Chapter 9.** United States Department of Agriculture, Washington, D. C.

Appendix F-4

DRAINAGE FOR IRRIGATED LAND

DESIGN CONSIDERATIONS

Drainage itself cannot protect downstream water quality, but since it is normally necessary for maintenance of productivity, the farm drainage system can be designed to minimize its impact on downstream quality.

Surface Drainage Considerations

Surface drainage on the farm is usually for removal of irrigation water runoff, but other purposes are intercepting surface water from higher land and removing precipitation runoff. Considerations for surface drainage include:

Topography: Land leveling or smoothing provides an even path for surface water to leave the field without soil erosion. On unleveled fields, natural swales may have to be developed as drainage channels.

Soils: Consideration should be given to the potential for silting for the surface drains. Also, the drains must be designed to minimize ditch erosion.

Inlets to Ditches: Where structures are used, proper location and type must be considered (See Appendix F-2 on Water Control Structures). Vegetated buffer areas may be appropriate to improve runoff water quality.

Outlets: Ditches should have adequate fall into a definite natural or constructed channel outlet or a sump from where the water can be pumped. Downstream water quality can be protected if the surface drainage water is recirculated in a tailwater recovery system.

Maintenance: Access must be provided for regular maintenance including cleaning, spraying, and repairs.

Subsurface Drainage Considerations

Subsurface drainage on the farm using tile or open drains is for removal of excess water from the soil to maintain an unsaturated crop root zone and/or to maintain a favorable salt balance in the soil. Considerations for subsurface drainage include:

Sources of Subsurface Drainage Water: Relief of water table originating on the farm and the interception of ground water flows from on or off the farm will affect the design of subsurface drainage systems.

Topography: Broad flat fields may be better suited for relief drainage while benches and swales may call for interceptor type drains. Pumping for drainage may be preferable with basin type topography underlain with good aquifer material.

Soils: Permeability, which is affected by soil texture, stratification, and structure, will affect the depth and spacing of drains. Wider spacings may allow use of open channels for subsurface drainage.

Crops: Sensitivity to salts and rooting depths of crops will affect depth and spacing of drains, in addition to soil factors.

Outlets and Conveyance: Subsurface drainage outlets should be designed to handle the maximum discharge of drainage water. Open channels and buried tile or pipeline systems are options for removing drainage water. Where elevations dictate, sumps may be used to provide adequate outlet of drainage water.

As with surface drainage systems, the downstream water quality can be protected by incorporating a tailwater recovery system into the design. Local regulations and drainage water quality may sometimes allow the return of drainage water to the stream without degradation.

DESIGN SPECIFICATIONS

The investigation for, and design of, surface and subsurface drainage systems is site specific and should be performed by experienced qualified professionals. References for drainage investigation and design criteria include:

Houston, C. E., 1967. **Drainage of Irrigated Land**. Circular 504, California Agricultural Experiment Station, University of California, Davis, California

Luthin, J. N. (editor), **Drainage of Agricultural Lands,** No. 7 in the series, Agronomy. American Society of Agronomy, Madison, Wisconsin.

Soil Conservation Service, USDA, 1973. **Drainage of Agricultural Land.** Water Information Center, Port Washington, New York.

Appendix F-5

LAND LEVELING FOR SURFACE IRRIGATION

DESIGN CONSIDERATIONS

Surface irrigation requires land over which water can flow evenly without causing erosion and which has a soil environment suitable for the planned crops. This normally requires land leveling. There are three general areas of consideration in planning and designing land leveling for surface irrigation: Site Suitability, Land Leveling Preparation, and Land Leveling Operation.

Site Suitability

1. Soil Permeability: Soils with excessive permeability, such as very sandy or gravelly soils with intake rates greater than three to four inches per hour, may not be suitable for surface irrigation and, leveling because of potentially low application efficiencies.

2. Soil Depth: The soil after leveling must be of sufficient depth to support good crop growth. In some instances, ripping, slip plowing, deep plowing, and/or the addition of organic matter and soil amendments will modify the resultant depth to where it may be satisfactory.

3. Topography: Rough topography may increase earth-moving costs to where it is impractical to level.

4. Drainage: Very permeable soils with a high water table lying within closed basins or floodways constitute serious limitations to the advisability of leveling the land.

5. Water Supply: Low available flows are not suggested for surface irrigation on very permeable soils which make the advisability of leveling questionable.

Land Leveling Preparation

1. Timing: Earthmoving should not be undertaken when the soil is moist. If it is, compaction may occur.

2. Clearing: All brush and trees should be removed. Stumps and roots should be grubbed to a depth of about six inches. It is often advisable to disk down all vegetation.

3. Rough Grading: Where relatively sharp irregularities exist, such as ditches, ridges, and hummocks, they should be reduced within reason with a dozer. This will increase the accuracy of the earthwork calculations.

4. Staking: The area should be staked on an even grid, usually 100 foot spacings, and oriented relative to the longest straight side of the field. The first row of stakes should be one-half the grid spacing from this field side. Where a sharp break in topography occurs, it would be advisable to place at least one additional stake, usually at half the grid spacing, in the grid at the topographic break.

5. Surveying: The relative elevations of all grid corners must be determined by surveying or laser methods. The spot for rod readings should be selected to represent the average elevation near the stake.

6. Base Map: A base map should be prepared showing field boundaries, all grid stations, and the original and final elevations and cut or fill at each station. Contours should be drawn at reasonable intervals.

7. Areas of Separate Leveling: If the entire field should not be leveled as a unit, as determined by inspection from the base map considering relatively sharp changes in topography, the separate units should be identified on the base map.

8. Earthwork Calculations: The depth of cut or fill at each grid station is calculated by conventional methods or with a computer. Factors to be considered are irrigation slope, cross slope, appropriate cut-fill ratio, amount of borrow necessary to fill any large depression, and amount of waste necessary to build a roadway or ditch pad. The slope factors are determined by the soil limitations and the planned crop. The cut-fill ratio is estimated considering the soil type and type of equipment to be used. The waste and/or borrow is estimated or calculated.

9. Posting: The cut or fill is posted on each grid stake. The level for fill is indicated with blue crayon or paint from the ground surface, and the depth of cut is indicated with red crayon or paint from the top of the stake. A station at finish grade elevation should be indicated by a red or blue circle.

Land Leveling Operation

1. Selection of Contractor: The contractor selected should be one with experience and the proper type and amount of equipment to accomplish the leveling operation in a timely and dependable manner. A written contract stating all requirements should be executed. (Note: Laser Leveling is also a widely used practice on irrigated fields.)

2. Grade Tolerance: The grade tolerance at each grid station should be 0.1 foot for finish slopes less than two percent and 0.2 foot for slopes greater than two percent. All construction work should be checked prior to acceptance.

3. Planning: After land leveling is completed, the leveled surface should be planed in both diagonal directions, and finally, in the direction of irrigation.

DESIGN SPECIFICATIONS

The design specifications should be prepared by an experienced qualified professional. An experienced person should also perform the inspection during construction. The following references are sources for design specifications:

Marr, James C. 1957. **Grading Land for Surface Irrigation.** Circular 438, California Agriculture Experiment Station, University of California, Davis.

Soil Conservation Service, 1970. **SCS National Engineering Handbook, Section 15, Chapter 12.** United States Department of Agriculture, Washington, D.C.

Appendix F-6

LAND SMOOTHING

DESIGN CONSIDERATIONS

Land smoothing may be appropriate for surface or sprinkler irrigation. It is often necessary prior to land leveling. The important considerations for land smoothing are indicated in the following steps:

1. Clearing: The areas to be smoother should be cleared of brush and trees and grubbed of stumps and large roots.

2. Construction: The gullies and closed depressions should be filled and ridges reduced to a uniform topography so that complete surface drainage is achieved without concentration of runoff water. A dozer or earthmover will probably be required.

3. Planning: Finish land planning or floating should be performed following smoothing. If a landplane can be used, the size (length) will be determined by the height and areal extent of the remaining ridges.

APPENDIX G - AGRICULTURE

LIVESTOCK MANAGEMENT

Appendix G-1

RIPARIAN IMPROVEMENT GRAZING STRATEGY

The following is designed to provide information on how to develop a grazing strategy to improve your riparian and wetland areas.

No one knows better than the people who move the stock that grazing western rangelands is a complicated business. The more one learns about livestock ecological inter-relationships the more complex it gets. However, complexity should not impeed business, the repair of riparian and wetland areas, or the protection of water quality.

The kind and degree to riparian and wetland grazing problems vary from site to site. However, there are a few simple common denominators which apply universally. These denominators are:

Livestock follow the green;

Riparian vegetation typically is quite different than plants on adjacent uplands; and,

Grazing strategies targeted exclusively on grasses may result in severe overgrazing of riparian areas and conversely too little upland vegetation in a riparian pasture may also result in overgazing.

These are two principles which must be followed to protect and/or restore wetland and/or riparian areas. These are:

1) exclude livestock from the riparian area with stream corridor fencing; or,

2) use other grazing strategies to limit the season, duration, and intensity of grazing on riparian areas. (i.e. develop alternate water sources; alter pastures, etc.)

The first step in developing a riparian improvement grazing strategy is establishing an objective. If rangeland watersheds are overstocked they will be overgrazed. Long-term productivity will deteriorate, no matter how well you manage your livestock. From a riparian/water quality perspective, how many head can be less important than where, when and for how long as livestock tend to concentrate in and overuse riparian areas at certain times of the year.

Management options to protect your riparian/wetland areas include stream corridor exclosures, riparian pasture management; and livestock management on both riparian and upland pastures. Each management option may require increasing levels of expertise.

However, any successful riparian grazing strategy will at minimum:

Limit grazing intensity and season of use to provide sufficient rest to encourage plant vigor, regrowth, and energy storage;

Ensure sufficient vegetation during periods of high flow to protect streambanks, dissipate stream energy and trap sediments;

Control the timing of grazing to prevent damage to streambanks when they are most vulnerable to trampling.

A basic grazing strategy can be derived by answering a few simple questions:

1) Which plants will grow and reproduce on each site? Which plants do you want to encourage; when do they put on new growth, produce shoots or seeds, store energy, become dormant?
2) When livestock are in the riparian areas, what plants do they prefer at different times of the year? When livestock are not in the riparian area, where are they and what plants do they prefer? When livestock are in the riparian area, are they under-utilizing upland vegetation?
3) What time(s) of the year are streambanks and riparian areas under most stress from high flows? When are streambanks most vulnerable to damage by livestock trampling?

The answers to these questions will get your thought process going, and help narrow options to those most likely to help you achieve your specific riparian improvement objectives.

Appendix G-2

SAMPLE GRAZING SYSTEMS

The idea of three pasture rest-rotation grazing is to put a number of cattle into a unit, graze it uniformly, move the cattle and progress accordingly to the other units. This is one of the most popular generic rangeland grazing strategies. Typically, rest rotation grazing provides for grazing a pasture in spring the first year, summer the second and no grazing the third year.

The basic theory is to graze cool season grasses early and heavy the first year and then give them the summer to recover, produce seed, and store energy in roots. The second year, the grasses are rested until after the seed ripens, then grazing is initiated. The third year the unit is rested.

Warm season grasses are grazed lightly early the first year, heavy the summer of the second year, with total rest the third year. With attention to the degree of plant utilization, this grazing strategy has produced good results for upland grasses. A full year's rest the third year allows cool and warm season grasses to build root reserves and litter.

Generally practiced, this strategy is good for sedge-rush-grass communities. It often is detrimental to riparian tree seedlings and brushy species, especially willows. Livestock can consume two or three years growth in one summer grazing period. Close attention to woody species utilization generally is necessary for this grazing strategy to result in improved condition of brushy riparian vegetation especially where willows are limited.

Grazing plans as shown in system #1-#3 are good management practices.

System #1: Two Unit - Summer Range - Alternate year rest.

1st Year		2nd Year	
Unit #1	Unit #2	Unit #1	Unit #2
Rest	Graze	Graze	Rest

Begin Grazing the unit when key vegetation* is ready. Remove livestock when proper range utilization is attained and provide total growing season rest for grass species every other year. Spring grazing may help ailing riparian woody vegetation while summer and fall grazing is potentially harmful to riparian shrubs and tree seedlings. Under proper management, this grazing strategy may maintain or improve low gradient grass/sedge riparian areas, but depending upon

duration and timing it may be detrimental to reestablishment of shrubs and woody vegetation. Repeat, beginning with the first year to make the two pasture rest system continuous.

*Key vegetation includes the plant species to be managed for in the unit.

System #2: Three Unit - Summer Range - Rest every third year.

	Unit #1	Unit #2	Unit #3	
1st year	Rest	1st	2nd	Begin grazing when the key vegetation* has sufficiently developed which may vary by plant species.
2nd year	2nd	Rest	1st	Unit #1 is rested for the entire first year and during the first half of the second year.
3rd year	1st	2nd	Rest	Move livestock when proper use of vegetation is reached in the units.
4th year	Rest	1st	2nd	Repeat beginning with 1st year to make system continuous.

Generally when the soil is firm plants have had an opportunity to make good growth. Early maturing grasses should have seed heads and others should be at least six inches tall.

*Key vegetation includes the plant species to be managed for in the unit.

System #3: Four Unit - Rest one year of four

	Unit #1	Unit #2	Unit #3	Unit#4
1st Year	Rest	Graze Spring	Graze summer	Graze Fall
2nd Year	Graze Fall	Rest	Graze Spring	Graze Summer
3rd Year	Graze Summer	Graze Fall	Rest	Graze Spring
4th Year	Graze Spring Summer	Graze	Graze Fall	Rest

Spring - Allow vegetation readiness - four to six inches high depending on species managed.

Summer - Vegetation possibly mature and in seed head.

Fall - Vegetation at seed maturity.

Analysis of the four pasture system indicates that after each pasture is rested, the next two years allow for grazing when vegetation is mature. A four pasture system should meet all livestock and vegetation requirements. Five pastures are even better, allowing for seed maturity and new seedling development. One of the hazards of spring and early summer grazing is the trampling and the displacement of new seedlings by livestock.

Rest-Rotation grazing systems work best where the units are nearly equal in carrying capacity. At a minimum, each unit must have enough capacity to feed the number of cattle over its required part of the grazing season. Each unit should reach vegetative readiness at approximately the same time or each pasture should have enough early feed to hold until higher elevation vegetation has a chance to develop to the state of range readiness.

Early Grazing

Graze early during the grass growing season; early spring in cool season areas, early summer in warm season areas. This strategy usually results in good dispersal of cattle and minimizes use of riparian woody plants. Additionally, herbaceous plants are allowed to rest during most of the critical late growing period which promotes plant vigor, seed production and energy storage in roots. It is important to note that early foliage growth is from root reserves and heavy grazing every year at this time can seriously damage preferred plants.

The early grazing strategy has potential to improve riparian wood vegetation. Utilization of grasses must be carefully controlled. In may areas, wet streambanks may be susceptible to trampling damage under this grazing strategy; potential may be minimized due to good dispersals of cattle.

Riparian Exclosures/Irrigated Pastures

Repairing damaged riparian areas within intensively managed irrigated pastures presents a special management challenge. A typical approach is to place the riparian area in a separate pasture with special management standards, or to exclude livestock from the riparian area. Corridor fencing can be integrated into a new system of pastures to allow better management and increased livestock forage, while improving water quality and the aesthetic and future economic values of the ranch.

References

Soil Conservation Service, USDA, 1976, **"National Range Handbook"**, Washington, D.C. **Livestock Grazing on Western Riparian Areas**, U.S. Environmental Protection Agency 1993.

Appendix G-3

PROPER GRAZING USE GUIDELINES

Key Grazing Areas and Key Species

Each pasture or grazing enclosure is a management unit for grazing land. Every unit has different characteristics of soil, topography, size, location of water, etc. that will influence distribution of grazing. While it is not practical to prescribe grazing use for all parts of a grazing unit, key grazing areas within each unit should be selected for planned grazing in order to meet the needs of the plants in the key areas. When the key grazing areas are properly grazed, the pasture as a whole will not be excessively used as long as key grazing areas in each grazing unit have been properly selected.

Most plant communities in a pasture consist of several plant species in varying densities. The entire plant community is of concern to proper management, but it is not practical to obtain desired use of all plants. It is more practical to select a single species to serve as a guide for utilization of the entire plant community. If key species are properly utilized, the entire plant community will not be excessively grazed, although minor constituents may.

Selecting Key Grazing Areas

1. Key grazing areas should be selected after careful evaluation of the current pattern of grazing in the pasture.

2. The areas selected should provide a significant amount of the available forage in the unit but not necessarily the major amount.

3. Key areas should be representative because of factors such as topography, nearness to water, and other favorable factors that influence grazing distribution. Areas of concentration, such as around watering facilities, shade or salt, should not be selected as key areas, nor should areas remote from water or with limited accessibility.

4. It may be necessary to select new key grazing areas when the grazing pattern is significantly altered by changes in season of use, class or kind of livestock, water developments, fencing or other factors that affect grazing distribution. Distribution of livestock use can be altered by providing expanded watering sources using solar and ram pumping systems.

Selecting Key Species

1. Key species should be palatable during the planned grazing season and preferred over associated species by the type of animals being grazed.

2. Key species should provide 15% or more of the readily available forage in the key grazing area. A species providing less than 15% of available forage can be used as a key species if it has a potential for greater production or is critical to the needs of the grazing animals.

3. Key species selected must be consistent with the management objectives for the plant community. These might include: (a) Maintaining a near-climax plant community; (b) Restoring near-climax conditions; or (c) Perpetuating a plant cover somewhat different from near-climax conditions. For (a) and (b), the key species should be a major component of the climax plant community.

Degree of Grazing Use

The objective of grazing management is to maintain or improve the plant community for protection of soil and water resources and to maintain or increase production of renewable forage resources through proper grazing use. The proper degree of use for key plant species is a guideline or reference point to be used in evaluating the condition of the plant community. Determining the trend in condition of the plant community is the major concern.

1. Specifications for the proper degree of use of native species should be based on locally adapted research data or local experience.

2. Research and experience indicate that the amount of grazing use that native plants can tolerate varies according to the kind of plant, season of use, soil, climate, plant vigor and amount of use to which competing plants are subjected. In general, research and experience show that most native herbaceous forage plants remain vigorous and productive if 50% by weight of the annual production remains at the end of the growing season.

3. If grazed during the dormant season, use should generally not exceed 60% by weight of the annual growth of key grasses and forbs.

4. Generally not more than 65% by weight, of the current year's growth of browse species should be used.

5. A significantly greater percentage of annual growth may be safely removed from some native plant species if pastures are grazed at high intensity for short periods and completely rested for longer periods.

6. The degree of use should be changed by managers if range condition trends indicate a need for more or less use.

The use of record forms (pages G-12 through G-17) like, or similar to, those on the following pages provide a means of recording degree of use for key plants and are helpful management tools in carrying out a program of proper grazing use.

RIPARIAN GRAZING USE

In planning riparian use some common sense observations are:

Each watershed, stream, stream reach, and riparian area has unique characteristics that must be accounted for in developing a grazing strategy to improve degraded riparian conditions and water quality.

No one grazing strategy fits all conditions. Any off-the-shelf grazing strategy likely will have to be modified to fit your specific condition, and updated as conditions change.

A grazing strategy is only as good as the management that goes into it. A high level of management can make almost any grazing strategy work. A low level can make almost any strategy fail.

Riparian exclosures and riparian pastures reduce management complexity and enhance the odds and speed of achieving riparian improvement objective.

When grazing riparian areas within upland pastures, one or both of the following management techniques probably will have to be added to your grazing strategy to improve degraded riparian areas:

1. Provide water, salt, supplemental feed away from riparian areas.

2. Herd to limit livestock use of riparian areas.

3. Initiate grazing when upland vegetation is palatable.

4. Grazing with a large herd for a short time may increase distribution.

MONITORING RESULTS

It's important to monitor on a continuous basis the effects of changes in grazing management to check progress toward long-term objectives.

Some riparian and wetland areas will recover fast while some sites will be slow to recover. Responses important from a water quality perspective may be gradual and only become obvious over time.

Ranchers typically keep detailed records on animal performance from year to year. Therefore, it would not be difficult for the rancher to record how key plant species, the overall riparian area and stream, and key upland plants respond to changes in grazing management.

Another method to monitor results is to take annual photographs of the same representative areas. Establish a few photo points (easily accessible, easily recognizable, permanent landmarks) from which to shoot each years photos. Supplement to photo albums with notes on your observations of the condition and trend of riparian vegetation, streambanks and stream channel. Don't forget to do the same for key upland sites.

Over time these records will clearly reveal progress or lack of it, toward long term objectives that may not be readily apparent at any given point in time.

References

Soil Conservation Service, USDA, 1976, **"National Range Handbook"**, Washington, D.C. **Livestock Grazing on Western Riparian Areas**, U.S. Environmental Protection Agency 1993.

INSTRUCTIONS

PROPER GRAZING USE - GRASSES AND FORBS

Grazing Unit: Enter in this column the name or number of the pasture or field.

Acres: Enter in this column the acreage of the grazing unit.

Species of Grazing Animal: Enter in this column the species and class of livestock being grazed such as: dry cows, cow-calves, ewes and lambs, yearling cattle, two year steers, yearling sheep, goats, deer, and horses.

Season of Use: Enter in this column the season that the unit will be grazed, such as: fall, winter, spring, summer, or by month: September-October, November-March, etc.

Location of Key Grazing Area: Enter in this column a description of the key grazing area. This may be a range site or it may be a portion of a site, or possibly a particular location within the grazing unit such as: South West portion of grazing unit starting about 200 yards from pond to fence.

Key Plant(s) for Judging Proper Grazing Use: Enter in this column the species by common name on which proper grazing use will be judged. There may be occasions when you will select two species; in that case enter the name of both species.

Planned Use of Key Species at End of Grazing Period: Enter in this column the percent by weight of the current year's growth of the key species that should be left ungrazed at the end of the grazing season.

Estimated Use of Key Species by Weight: Enter in this column by calendar year the estimate of the actual use the grazing unit received. This estimate should be based on the key species on the key grazing area, at or near the end of the grazing period, or on year-long grazing, just prior to the next growing season.

FIGURE G-1 (GRAZING.USE)
PROPER GRAZING USE

JUDGING UTILIZATION, TREND AND CONDITION OF BROWSE PLANTS

REPRODUCTION

1. For Key Species Three categories as follows:

Adequate:	Sufficient seedlings and young plants to maintain or increase status of species in the community.
Some but Inadequate:	Some seedlings and young plants present, but not enough to maintain status of species in the community.
Little or None:	The species is not reproducing. Plants mostly mature or decadent. Few or no seedlings and/or young plants.

2. For Low Quality Species Three categories as follows:

Excessive:	More seedlings and young plants than required to maintain species in the community. Species obviously increasing.
Adequate:	Sufficient seedlings and young plants to approximately maintain status of species in the community. Stable population.
Little or None:	Very few seedlings or young plants becoming established. Species is declining in the community.

INSTRUCTIONS FOR JUDGING UTILIZATION OF BROWSE PLANTS

CURRENT GROWTH

1. Utilization during the growing season: Proper use is when 50 percent by weight or less of the available twigs, leaves, and fruits have been removed during the growing season.

2. Utilization during the dormant season: Proper use is when 65 percent by weight or less of available twigs of deciduous species, or twigs and leaves of evergreen species have been removed.

(NOTE: These percentages could be used unless local research indicated otherwise. The above percentages are determined on the basis of weight of current year's growth as determined by ocular estimates or a combination of harvest and estimates.)

CHECKING TREND AND CONDITION OF BROWSE PLANTS

EVIDENCE OF PAST YEAR'S USE

1. Hedging Three categories as follows:

Not Evident	Little or no evidence of hedging of plants.
Moderate	Up to half the plants plainly show evidence of hedging.
Severe	More than half the plants plainly show evidence of hedging.

2. Browse Line Three categories as follows:

Not Evident	No browse line distinguishable from a distance. Production on lower twigs similar to that of twigs beyond reach of animals.

Moderate	Browse line apparent from a distance, but lower twigs still reasonably productive.
Very Apparent	Browse line strikingly evident. Little or no production on twigs within reach of animals.

(NOTE: Browse lines may be permanent with some species such as Antelope Bitterbrush and may actually reflect historical grazing management.)

FIGURE G-2 (FIG J2.PCX)
JUDGING UTILIZATION, TRENCH, AND CONDITION OF BROWSE PLANTS

Appendix G-4

GUIDE FOR CONSTRUCTING STOCK TRAILS

Stock trails are often needed to obtain better livestock distribution and to provide access to water where steep slopes, rimrocks, rock slides or other obstacles impede livestock movement.

Guidelines and Specification

1. Do not construct trails through critical erosion areas.

2. Trails should be at least two feet wide.

3. Bridges crossing gullies should be at least six feet wide.

4. Maximum grade for trails should be 20% except for short distances to bypass barriers or danger areas. Every effort should be made to keep trails less than 20%, particularly in areas of live streams or canyon crossings.

5. Locate trails to avoid switchbacks if possible.

6. Install waterbars, drains or other structures as needed to control runoff and erosion.

7. Avoid canyon bottoms or draws where possible.

8. Revegetate critical areas created by construction. (See Critical Area Planting Guide)

Appendix G-5

STOCKWATER DEVELOPMENT GUIDELINES

Spring Development

Fracture and Tubular Springs: Where water issues from fractures, the individual openings should be cleaned and enlarged as needed to provide an increase in flow. The water from these individual openings should be collected and conveyed to a central sump or spring box by means of a tile or perforated pipeline or by a gravel filled ditch. The collection works should be below the elevation of the openings to permit free discharge.

Where water issues from a single opening, such as solution channels found in rock formations or tunnels in lava, the opening should be cleaned or enlarged as needed. A collection system usually will not be needed, but a spring box or sump should be installed. The spring box or sump should be low enough to prevent ponding over the spring opening.

Perched or Contact Springs: Perched or contact springs occur where an impermeable layer outcrops beneath a water-bearing permeable layer. These springs should be developed by intercepting and collecting the flow from the water bearing formation. Collection trenches are used for developing these types of springs.

Artesian Springs: Artesian springs should be developed by removing obstructions, cleaning or enlarging joints or fractures, or by lowering the outlet elevation. Sumps and spring boxes should be located so as to hold ponding over the spring outlet to a minimum.

Spring Collection Systems: Where a collection trench along the outcrop of the waterbearing formation is to be used, the trench should be excavated into the pervious layer.

An impervious cutoff wall of well tramped clay, masonry, concrete or other suitable material should be constructed along the downstream side of the trench where needed to direct the flow into the collection system.

The collection system should consist of a drain tile, perforated pipe, or a wood box drain enclosed in a sand-gravel filter. A crushed rock or gravel backfill, not less than 12 inches deep, can be used in lieu of these types of drains. The collection system should outlet into a spring box.

Spring Boxes: Spring boxes should be made of durable material and have a tight, removable cover. The boxes should have a minimum cross sectional area of 1-1/2 square feet.

The floor of the spring box should be at least six inches below the outlet of the collection system.

Spring boxes for perched springs should be floored with concrete or other stable impervious material unless the natural underlying material is solid and impervious.

Spring Outlets: The outlet pipe from a spring box should be placed about six inches above the floor of the box to provide a sediment trap. The outlet should not be high enough to create a head on the spring that would reduce flow. The outlet pipe should be installed with a watertight connection to the spring box. Measures required to protect the development from damage by freezing, flooding, sedimentation, contamination and livestock should be included in the design. The water should be piped into tanks or troughs suitable for livestock use.

Natural Resource Considerations: With any spring development natural resource considerations should be incorporated into the project design. Sufficient water should be left at the spring to maintain riparian vegetation and for wildlife resources. If the spring will only be used a portion of the year for livestock watering the spring development should be designed to allow water to remain at the spring site during periods of non-use. All livestock watering troughs should be constructed in a manner which provides wildlife escape routes. Spring developments must be well maintained and periodically inspected.

Wells

The feasibility of development and type of well installed should be based on reliable local experience or on detailed investigations including test wells and geologic and hydraulic analysis. All well development must be conducted in accordance with federal, state and local regulations.

Casing and Materials: Wells should be cased, except that the lower section of a well passing through consolidated strata does not require casing. Installation and construction must comply with county codes and state water laws.

Screens: All wells finished in unconsolidated aquifers should be equipped with manufactured screen sections, well points or field perforated sections. The screen openings for aquifer material of near uniform size should be slightly smaller than the average diameter of the aquifer material. For graded aquifer materials (of non-uniform gradation), the screen openings should be such that 25 to 40 percent of the aquifer material is larger than the screen openings. In wells using a gravel pack envelope, the screen should have openings of a size that will exclude at least 85 percent of the gravel pack material. The length of the screen should be sufficient to maintain the entrance velocity of water into the well at an acceptable level.

The position of the screen in the well will be governed by the depth of the aquifer below the ground surface and the thickness of the aquifer penetrated by the well. Where practical, the top elevation of the screen should be below the lowest water level expected during pumping and located opposite the most permeable areas of the water bearing strata.

Gravel Pack: Filter packs should be used in wells developed in strata composed of fine material of relatively uniform grain size to prevent aquifer materials from passing through the well screen or perforated casing. The pack should be 3 to 12 inches thick and should be composed of sand or gravel material with a grain size 5 to 12 times that of the strata material.

Well Installation Requirements

Alignment: Drilled wells should be round, plumb and aligned so as to permit satisfactory installation and operation of a pump of the desired size and type, at the grids anticipated depth of setting.

Casing Installation: In consolidated formations, the casing should extend from the ground surface through the overburden material to an elevation at least two feet into the consolidated foundation.

In unconsolidated formations, the casing should extend from the ground to the screen. For artesian aquifers, the casing should be sealed into the overlying impermeable formations to retain the artesian pressure.

When a formation bearing water of poor quality is penetrated, the formation should be sealed off to prevent the infiltration of poor quality water into the well and the developed aquifer.

Plastic well casing should be equipped with a steel driving shoe and be placed with as little driving as possible.

Protection: All wells should be sealed at the ground surface to exclude the entrance of surface and near surface water. The State of Nevada has regulations which govern water wells and related drilling. These regulations are administered by the Division of Water Resources, State Engineers Office (NRS Chapter 534). Water should be piped to tanks or troughs suitable for livestock use.

Ponds: When free flowing springs are not available and the ground water situation is such that well drilling is not feasible it may be possible to develop stockwater with ponds in draws or canyon bottoms. The general types of ponds are used, embankments ponds and excavated ponds. An embankment pond is created by constructing a dam across a stream or waterway. An excavated pond is created by digging a pit or dugout. On some sites a combination of excavation and dam construction is used. Ponds often supply water only for seasonal use. (**Note: If the pond will impound greater than or equal to 20 acre feet of water, a permit may be necessary. Contact the State Engineers Office.**)

Embankment Ponds

1. **Dams should be designed by a qualified engineer and must meet requirements of State statutes and recognized water rights**.

2. The pond site should be located so excess runoff can be safely passed through a natural or constructed spillway.

3. Topography and soils of the site should permit storage of water at a depth and volume adequate to meet needs of the intended use. Soils should be impervious or of a type that sealing is practical.

4. Water should be piped through the dam to livestock troughs or tanks and the dam and pond area fenced.

5. Where precipitation is adequate, the dam and disturbed areas should be revegetated. (See Appendix E-1, "Critical Area Planting Guide".)

6. Where surface runoff is the main source of water, the pond should be located where the contributing drainage area is large enough to yield sufficient runoff to meet the intended use.

Excavated Ponds

1. Excavated ponds may be fed by surface runoff or ground water aquifers.

2. Ponds fed by surface runoff can be located on almost any type of topography, but are most satisfactory in areas of comparatively flat terrain in broad natural drainage ways.

3. Excavated ponds fed by ground water are located where shallow underground water exists or where there is a permanent water table within a few feet of the surface.

4. Excavated ponds fed by surface runoff should be located on relatively impervious soils. Ponds on porous soils must be sealed.

5. Locations with favorable discharge conditions for overflow waters should be selected. Sites where overflow escapes through natural drainageways are desirable.

6. Excavated ponds can be constructed in almost any shape but a rectangular shape is usually most efficient.

7. Pond size should be adequate to provide the amount of storage needed for the intended use.

8. Side slopes should normally be 2:1, but certain soils may require flatter slopes. A ramp with

a slope of 4:1 or flatter should be provided at one or both ends for livestock access. The ramps should be designed to minimize soil erosion and damage to the structure by livestock.

9. Excavated material should be placed where it will not endanger stability of pond side slopes or be washed back into the pond.

10. Except for access, ramps, the pond area should be fenced. Where feasible, excavated material should be revegetated. (See Critical Area Planting Guide)

Pipelines

Pipelines can be used to convey water from an established source to parts of the range without a water supply. With an adequate water supply, a number of watering facilities can be placed along a pipeline. Where possible, facilities should be located about one mile apart. If water from the pipelines is likely to be used for human consumption, the installation must meet requirements of State and County health agencies.

1. Pipelines should have the capacity to provide a minimum of 12 gallons of water per day per head for beef cattle or horses, and 1 1/2 gallons per head for sheep and goats at each facility serviced by the pipeline.

2. Pipelines should be placed so they are protected from traffic hazards, farm operations, freezing or soil cracking.

3. Trenches for plastic pipe should be free of rocks. The pipe should be placed in a snakelike fashion.

4. Valves should be placed at low points so the line can be drained as needed.

5. Vents are usually required for removing air from the system.

6. Watertight joints should have a strength equal to the pipe. Couplings should be of material similar to the pipe or well insulated.

7. Pipelines should be tested for several days after installation and all visible leaks repaired.

8. Properly designed tanks and troughs for livestock watering should be located at each facility.

Hydraulic Rams

A hydraulic ram is a pump operated by water power. It uses the power developed by a given quantity of falling water to force a much smaller quantity to an elevation above the source of supply. Hydraulic rams can be used for livestock water facilities along streams where livestock access to the stream is difficult or where streambanks must be protected from livestock due to critical erosion problems, or other sources of continuous supply.

The following data is needed to design a hydraulic ram installation:

1. Fall in feet from source of supply to the site of the ram.

2. Pipe length to conduct water from source to the ram.

3. Height in feet water is to be raised - vertical distance between the ram and the delivery point.

4. Supply of water available to the ram in gallons per minute.

5. Length of pipe required to conduct water from the ram to the delivery point.

6. Volume of water required in gallons per day.

The following data is needed to design a solar pumping system:

1. Well depth or description of water source.

2. Depth to water surface: Does it vary? If so, how much?

3. Yield of well estimated in gallons (or liters) per minute.

4. Total vertical lift from water surface to storage tank or pipe outlet.

5. Size of well casing (inside diameter).

6. Quality of water: Is it clear, silty or mineralized?

7. Water requirements in gallons (liters) per day, according to season.

8. Application for water: Home? Livestock? Irrigation?

9. Is pressure required for home, sprinkling?

10. Can a storage tank be easily located higher than the point of use?

11. Is the pump to be located near a home/battery system? Distance?

12. Elevation above sea level (to determine suction limitation).

13. Geographical location of system.

14. Solar access is unobstructed sunlight available near water source? If not how far?

15. Complex terrain? Draw map or diagram.

16. Describe existing equipment for pumping, distribution, storage, etc.

17. Is this system to be the only source of water available.

Guide to Estimating Water Requirements:

Large Livestock (Cattle):	10 gallons (40 liters) per day in dry weather.
Small Animal:	1/4 gallon per day per 25 lbs of body weight (1 liter per 10 kg.).
Poultry:	6-12 gallons (20-50 liters) per day hundred birds per day.
Young Trees:	15 gallons (55 liters) per day in dry weather.
NOTE:	These figures will vary with ambient temperature.

Appendix G-6

FENCING - GUIDELINES

Fences are needed in a number of land treatments for water quality management:

1. To exclude livestock, wildlife and federal horses from critical erosion areas, areas of toxic wastes from mining or other industry, and from critical riparian zones.

2. To control access of vehicles and people to critical erosion areas and danger zones.

3. To subdivide grazing lands and regulate grazing use.

4. To protect revegetation planting during the establishment period.

PLANNING CRITERIA

1. Design fence to meet the specific objectives of the project.

2. Where legal fences are needed, they must meet the requirements of State Statues of Nevada and the Federal land manager.

3. Select fencing materials on the basis of availability, cost, soil conditions, and objectives of the fence.

4. Where possible, avoid snowdrift areas, erosive soils, steep slopes and game migration routes.

5. Make maximum use of natural barriers.

6. Avoid creating livestock and wildlife traps; fences should not point in at sharp angles to other fences or natural barriers.

7. Fence lines should be clear of brush and trees.

8. Special provisions should be made where wildlife crossings are needed. Consult game management specialists.

STANDARD GUIDELINE SPECIFICATIONS

1. Space posts a maximum of 20 feet apart (wood posts for suspension fences a maximum of 120 feet).

2. Post sizes - wood posts six feet long with a three inch top diameter (corner posts seven to eight feet long with a five inch top); steel posts 5-1/2 feet long; 1-1/3 pounds per foot and with anchor plate. Wood posts, except juniper, should be butt-treated. Set posts 1-1/2 to two feet deep. Where higher fences are needed, longer posts will be required.

3. Brace post assemblies should be placed:

   (a) 1320 feet apart in a straight line fence on moderate terrain.
   (b) At each gate.
   (c) At each turn of 15 degrees or more.
   (d) At each point of change in the vertical angle of 10 degrees or more.

4. Barbed wire should be heavy duty galvanized, minimum gauge 12-1/2 with a minimum of four wires spaced 12 inches apart, top wire a minimum of 42 inches above the ground and bottom wire a maximum of 12 inches above the ground, except where passage of wildlife under the fence is desired.

5. Woven wire should be heavy duty galvanized with a minimum of one strand of barbed wire on top at a minimum of 42 inches above the ground. Chain-link fencing can also be used. High fences may be needed for certain uses.

6. Staples should be nine gauge or heavier, 1-1/2 inches long (2-1/2 inches for suspension fences.)

7. Use wire stays spaced 10 to 16 feet apart between posts on suspension fences. Special metal clips can be used in lieu of staples on suspension fences.

8. Electric fences can be used where temporary exclusion of livestock is needed, such as in range seedings.

9. Consider the use of solar electric fences when temporary fencing is needed to restrict use in critical riparian zones.

Appendix G-7

BRUSH MANAGEMENT GUIDELINES

Mechanical, chemical and biological procedures and controlled burning are used singly or in combinations depending upon the site specific factors of the treatment area. Site specific factors may include land use, topography, woody plant species (sprouters or non-sprouters), treatment hazards, plant species size, density and distribution, treatment objectives and costs.

The use of non-chemical treatments is advised whenever it is feasible and practicable. The amount of land disturbance and resulting sediment transport should be considered. Phenological development of the plant species being controlled and of the plants being favored is of prime importance. Select the time when plants to be controlled are most vulnerable to the specific treatment. For growth regulating chemicals, this is a time of most active growth. Mechanical treatment is most successful just prior to seed maturity when root reserves are lowest.

Brush Management Planning Techniques -

* Defer grazing prior to brush management activities that are designed to improve the resident forage species.

* Tailor grazing management to favor the key species following brush management.

* Leave sufficient herbaceous plants, shrubs and trees to maintain desirable wildlife habitat, migration and escape routes.

* Provide for preservation of natural beauty to the fullest extent possible. This could include strategically located and irregularly shaped patches, avoiding rectangular shapes.

* Provide view barriers of untreated land 100 to 200 feet wide along major roads and perennial streams.

Brush Management Treatments -

Plowing -

* Adaptation: Low shrubs on sites planned for seeding.
* Equipment: Disk or moldboard plow; heavy offset disk, root plow.
* Dates: Late spring to early fall before shrubs have matured seed. Soil should be dry enough to prevent regrowth of partly covered plants.
* Operation: Plow below root crown. Operate disk at a sharp angle. Repeat as necessary.

Chaining -

* Adaptation: Pinyon, juniper, or sagebrush stands that are predominantly mature and brittle. Less effective on young, limber plants or those that resprout. Adapted to sites that will be seeded or for improvement of native range with less than a full stand of forage plants.
* Equipment: A 70 to 90 pound anchor chain, modified by welding rails to each link and installing swivels on each end.
* Dates: Same as for plowing.
* Operation: Pulled between two tractors, twice over in opposite or diagonal directions. May be broadcast or drill seeded between operations.

Beating -

* Adaptation: Stone-free sites with low shrubs that do not readily resprout. Not adapted to rabbitbrush, snowberry, silver sagebrush, three-tip sagebrush or Anderson peachbrush. Adapted to sites that will be seeded or managed for natural improvement.
* Equipment: Flair beaters or circular cutters.
* Dates: Same as for plowing.
* Operation: Cut as near ground level as possible. Adjust travel speed to brush conditions.

Controlled Burning - **NOTE: Please see BMP 7-2**

* Adaptation: Big sagebrush or other non-sprouting brush or trees on sites planned for seeding. Heavy stands of nonsprouting shrubs or trees with good understory of desirable forage plants.
* Equipment: Farming or land grading machinery to prepare firebreaks; weedburners.
* Dates: Brush should be burned in mid or late summer after understory is dry but before brush seed has been dispersed. Grass root reserves should be high after seed maturity. Cheatgrass should be burned in late spring just prior to seed maturity. NOTE: It is imperative that the necessary state and local burning permits are obtained prior to burning activities.
* Seeding: Seed burned areas as soon as possible after burning.

Chemical -

* Use only approved chemicals as regulated by the Nevada Division of Agriculture.
* Apply in accordance with pesticide labeled use registered with the Nevada Division of Agriculture. Always read the label on the pesticide container before using the material. **NOTE: Please see BMP 7-7 and BMP 10-8.**

Biological -

* Introduction and fostering of the target plant species natural enemies and competitor's.

APPENDIX H - FOREST RESOURCE MANAGEMENT

H-1 STANDARD FOREST PRACTICES RULE
H-2 WILDLAND/URBAN INTERFACE MANAGEMENT
H-3 FUELS MANAGEMENT

Appendix H-1

AMENDED FOREST PRACTICE RULES

Standard Forest Practice Rules

ARTICLE 1. INTRODUCTION

1.0 Statement of Purposes: The purpose of these rules is to establish standards in accordance with the policies set forth by the Nevada Revised Statutes. Rules promulgated herein apply to all timber lands and are to be used with exceptions for the zone where practice is to be applied. The rules are not intended to result in taking of private property for public use without payment of just compensation.

ARTICLE 2. DEFINITIONS OF TERMS

2.0 Definition of Terms: In these rules the following definitions shall apply, unless the context clearly requires otherwise:

2.1 Basal Area Per Acre. "Basal Area Per Acre" means the sum of the cross-sectional areas of the tree measured at 4.5 above the ground (dbh) diameter per acre.

2.2 Commercial Species: "Commercial species" means the following: Ponderosa Pine (Pinus Ponderosa), Jeffrey Pine (Pinus Jeffreii), Pinyon Pine (Pinus Monophylla), White Fir (Abies Concolor), Douglas Fir (Pseudotsuga Menziesii), Utah Juniper (Juniperus Osteosperma), Tamarisk (Tamarisk sp.), Sugar Pine (Pinus Lambertiana), Red Fir (Abies Magnifica), Western White Pine (Pinus Monticola), Mountain Hemlock (Tsuga Mertensiana), Incense Cedar (Libocedrus Decurrens), Western Juniper (Juniper Occidentalis), Aspen (Populus Tremuloides), Cottonwood (Populus sp.), Limber Pine (Pinus Flexilus), White Bark Pine (Pinus Albicaulus), Bristle Cone Pine (Pinus Aristata), Engleman Spruce (Picia Englemanii), Sub Alpine Fir (Abies Lasiocarpa), One Seed Juniper (Juniperus Monosperma).

2.3 Commercial Timberland: "Commercial timberland" is that forest land which is capable of and available for producing successive crops of commercial wood and generally capable of producing in excess of 20 cubic feet per acre of annual growth.

2.4 Countable Tree: "Countable tree" means:

(a) The tree must be in place at least two growing seasons.
(b) The tree must be alive and healthy.
(c) The tree must have at least one-third of its length in live crown.
(d) The tree must be a commercial species from a local seed source or a seed source which the State Forester's representative determines will produce commercial trees physiologically suited for the area involved.

2.5 Diameter or D.B.H: "Diameter or D.B.H." means the average diameter of a tree, outside the bark, at a point 4.5 feet above the ground level on the high side of the tree.

2.6 Erosion Potential: The "erosion potential" of an area should be estimated by considering the following factors:

2.6 TABLE FOR ESTIMATING EROSION POTENTIAL:

TABLE H-1

EROSION POTENTIAL RATINGS

FACTORS	1	2	3	4
Parent Rock	basic igneous basalt gabbro	sedimentary / metamorphic	sedimentary / metamorphic	acid igneous (granite)
Soil Texture	fine-medium clay/clay loam	fine-medium clay & loam	sandy sandy/loam loamy sand	sandy decomposed granite
Soil Depth	40" +	20" - 40"	20' - 40" clay subsoil	20" or less clay subsoil
Precipitation	heavy snow light rain	mainly snow some rain	mainly snow some rain	rain
Vegetative Cover	plant/litter 70% cover	plant/litter 50-70% cover	plant/litter 30-50% cover	plant/litter 30% or less
Slope	less than 20%	20 - 30%	30 -50%	55% +

USE OF TABLE FOR ESTIMATING EROSION POTENTIAL:

Add the rating factors for parent rock, soil texture, soil depth, precipitation, and vegetative cover. Multiply the sum by the rating factor for slope.

EXAMPLE:

Parent rock is granite	4	
Soil texture is sandy loam		+3
Soil depth is 20" - 40"	+2	
Precipitation is mainly snow, some rain		+2
Vegetative cover is 30 - 50%	+3	
Multiply sum by slope rating	14 x 3 = **42**	

Using the following guide the example area would have HIGH erosion potential:

EROSION POTENTIAL FORMULA RESULT

Less Than 20	Low
20-39	Moderate
40-59	High
More Than 59	Extremely High

2.7 Fire Protection Zone: "Fire Protection Zone" means that portion of the logging area within 100 feet, as measured along the surface of the ground, from the edge of the travelled surface of all public roads and railroads; and within 200 feet, as measured along the surface of the ground from permanently located structures currently maintained for human habitation.

2.8 Fuelbreak: "Fuelbreak" means a strip of modified fuel to provide a line from which to work in the control of a fire.

2.9 Lake: "Lake" means a permanent body of water, isolated from the sea, either natural or artificially impounded, and having an area of open water of sufficient depth and permanency to prevent complete coverage by rooted aquatic plants.

2.10 Logging Area: "Logging Area" means that area on which timber operations are being conducted as shown on the map accompanying the Timber Harvesting Plan, and within 100 feet as measured on the surface of the ground, from the edge of the travelled surface or appurtenant roads owned or controlled by the timber operator and being used during the harvesting of the particular area.

2.11 Logging Road: "Logging Road" means a road other than a public road used by trucks going to and from landings to transport logs and other forest products.

2.12 Lopping: "Lopping" means severing limbs from the exposed sides of unutilized portions of trees so that portions of the severed limbs are in contact with the ground.

2.13 Meadows and Wet Areas: "Meadows and Wet Areas" means those areas which are moist on the surface throughout most of the year and/or support aquatic vegetation, grasses and forbs as their principal vegetative cover.

2.14 Public Road: "Public Road" means a road open to the general public which is (a) in the state or county road system, or (b) a road on which a public agency has deeded unlimited easement.

2.15 Reproduction: "Reproduction" means young trees of commercial species that are less than two inches D.B.H., i.e., seedlings and saplings.

2.16 Seed Tree: "Seed Tree" means a firm coniferous tree with full crown now capable of producing seed.

2.17 Site Classification: "Site Classification" means the classification of productive potential of commercial timberland into one of five classes by board regulation, consistent with normally accepted forestry practices. Site I shall denote sites of highest productivity potential, Site II and III shall denote sites of intermediate productivity potential, and Site IV and Site V shall denote sites of lowest productivity potential.

2.18 Slash: "Slash" means split product material, branches, limbs or stems of any species left in the harvest area as a result of current timber harvesting.

2.19 Snag: "Snag" means a standing dead tree or standing section thereof, regardless of species.

2.20 Special Treatment Areas: "Special Treatment Areas" means specific areas that have been legally designated and described by the appropriate public agency or commission as: wild and scenic rivers, scenic highways, historical and archaeological sites (excepting old logging sites, abandoned railroad grades, mills or towns), ecological reserves, key habitat areas of endangered species of plants and animals; national, state, regional, county and municipal parks; and those areas within 200 feet, as measured along the surface of the ground from the established boundaries of such areas or the edge of the travelled surface of such highways.

2.21 Stream: "Stream" means a natural watercourse as designated by a solid line or dash and three dot symbol shown in blue on the most recently published United States Geological Survey 7 1/2 minute series topographic map.

2.22 Stream and Lake Protection Zone: Certain activities prohibited near bodies of water; exceptions:

1) No felling of trees, skidding, rigging or construction of tractor or truck roads or landings, or the operation of vehicles, may take place within 200 feet, measured on the slope, of the high water mark of any lake, reservoir, stream or other body of water unless a variance is first obtained from a committee composed of the State Forester Firewarden, the Director of the Division of Wildlife and the State Engineer.

2) The committee may grant a variance authorizing any of the activities prohibited by subsection one within a 200-foot buffer area if the committee determines that the goals of conserving forest resources and achieving forest regeneration, preserving watersheds, reaching or maintaining water quality standards adopted by federal and state law, continuing water flows, preserving and providing for the propagation of fish life and stream habitat and preventing significant soil erosion will not be compromised.

3) In acting on a request for such variances the committee shall consider the following factors:

(a) The extent to which such requested activity is consistent with good forestry management for the harvesting of timber.

(b) The extent to which such requested activity significantly impedes or interrupts the natural volume and flow of water.

(c) The extent to which such requested activity significantly affects a continuation of the natural quality of the water pursuant to state and federal water quality standards.

(d) The extent to which such requested activity is consistent with the prevention of significant soul erosion.

(e) The extent to which such requested activity may significantly obstruct fish passage, cause sedimentation in fish spawning areas, infringe on feeding and nursing areas and cause variations of water temperatures.

(f) The filtration of sediment-laden water as a consequence of timber harvesting on adjacent slopes.

2.23 Stream and Lake Transition Line: The "Stream and Lake Transition Line" means that line closest to the stream or lake where riparian vegetation is permanently established.

2.24 Tight-Lining: "Tight-Lining" means the moving of the main line from one tail block location to another and tightening the cable to pull the main line to the new position.

2.25 Thrifty Trees: "Thrifty Trees" means trees with usually long, full, pointed tops and lower limbs frequently dead, but containing very few dead limbs in the upper green portion of the crown. Such trees usually fall within Dunning's tree classes 1 and 2, and Keen's tree classes 1a, 1b, 2a, and 2b.

2.26 Timberland: "Timberland" means land, other than land owned by the federal government, which is available for, and capable of, growing a crop of trees of any commercial species used to produce lumber and other forest products, including Christmas trees.

2.27 Timber Operations: "Timber Operations" means the cutting or removal or both of timber or other solid wood forest products, including Christmas trees and firewood from timberlands for commercial purposes. Together with all the work incidental thereto, including, but not limited to, construction and maintenance of roads, fuelbreaks, firebreaks, stream crossing, landings, skid trails, beds for the felling of trees, and fire hazard abatement, (but excluding preparatory work such as tree-marking, surveying) or roadflagging. Removal or harvest of incidental vegetation from timberlands, such as berries, ferns, greenery, mistletoe, herbs and other products, which action cannot normally be expected to result in a threat to forest, air, water or soil resources, does not constitute timber operations.

2.28 Timber Operator: "Timber Operator" means any person who is engaged in timber operations or who contracts with others to conduct such operations on his behalf, except a person who is engaged in timber operations as an employee as his sole compensation.

2.29 Timber Owner: "Timber Owner" means any person who owns commercial timber, timberland, cutover land, or timber rights, including Christmas tree rights, on lands of another except a federal agency.

2.30 Tractor Roads and Skid Trails: "Tractor Roads and Skid Trails" means constructed trails or established paths where the vegetation or ground cover has been removed and which are used by tractors or other yarding or skidding vehicles in harvesting forest products.

2.31 Waterbreak: "Waterbreak" means a ditch, dike or dip, or a combination thereof, constructed across tractor roads, skid trails, firebreaks and roads, diagonally where feasible, so that water flow is effectively diverted therefrom.

ARTICLE 3. SILVICULTURAL METHODS

3.0 Silvicultural Methods: The objective of this article is to provide for future continuous timber growth and to protect other resources on timberland, which will be at or near the productive capacity for the soil, timber site, and species present.

The Timber Harvesting Plan shall designate one or a combination of silvicultural methods. If some other silvicultural method other than those described below is to be applied, it shall be described and defined in the Timber Harvesting Plan. The timber operator or owners' representative shall state the objective of the harvesting method in the Timber Harvesting Plan. The selection of a silvicultural method should be determined by consideration of timber stand conditions, topography, land stability, erosion potential, slash treatment and visual aspects.

Lands on which Christmas trees, fuelwood, minor timber operations, or dead, dying or diseased trees are harvested may be exempt from these silvicultural methods by order of the State Forester. Each timber operator shall conduct his timber operations in accordance with the silvicultural method or methods described in the Timber Harvesting Plan filed with the State Forester.

Some of the most commonly used silvicultural methods are listed below:

3.1 Thinning Method: The "Thinning Method" provides for cutting and removing trees in a timber stand to increase the rate of timber growth, foster quality timber growth, and/or improve species composition, or recover and use timber that would otherwise be lost to mortality.

3.2 Selection Method: The "Selection Method" provides for the removal of timber usually covering a variety of age classes, either as single trees or in small groups, at relatively short intervals of time, commonly 5 to 20 years, repeated indefinitely, by means of which continuous establishment of natural reproduction is encouraged and an uneven-aged stand is maintained.

3.3 Shelterwood Method: The "Shelterwood Method" shall provide for the removal of mature timber in a series of cuttings, which extend over a period of years equal usually to not more than one-quarter and often not more than one-tenth of the time required to grow the crop to harvestable age. In this method, the establishment of natural reproduction under the partial shelter of seed trees is encouraged.

3.4 Seed Tree Method: "The Seed Tree Method" provides for the removal of timber in one cut except for the seed trees to be left to restock the logged area. An average of at least ten mature trees, with a minimum of five trees of each logged area shall be more than 500 feet from the nearest seed tree as measured along the surface of the ground. Seed trees should be left in groups of at least three trees at least one of which is for each dominant species.

3.5 Clear-Cutting Method: The "Clear-Cutting Method" provides for harvesting of the entire timber stand in one cut on an area (clear-cut areas shall not exceed forty (40) acres in any one block). No clear-cutting shall be done on an area contiguous to a previously clear area in the same ownership until that area has been adequately revegetated. The boundaries of the clear-cut area should, where practical, follow the topography rather than section lines to make them irregular in shape to blend with the natural landscape. The cut areas shall not exceed 600 feet in width unless explained in the Timber Harvesting Plan.

3.6 Sanitation Salvage Cutting Method: The "Sanitation Salvage Cutting Method" provides for the cutting and removal of only those trees which are dead, dying, or deteriorating because of damage from fire, wind, insects, disease, flood, age, or other injurious agents.

3.7 Special Treatment Areas: Special consideration in "Special Treatment Areas" will be given to selection of a silvicultural method compatible with the objectives for which the special area was established. Such areas shall be identified in the Timber Harvesting Plan.

To assure the integrity of legally designated historical and archaeological sites and legally designated ecological reserves, the timber land owner or his designated representative and the State Forester may agree, after on-the-ground inspection, if requested by either party, on specific silvicultural and logging practices to protect such areas.

When a significant archaeological discovery is made during timber operations, it should be reported to the proper authorities. Timber operations should stop on that specific site to protect it for future evaluation.

3.8 Riparian Vegetation: All non-commercial riparian vegetation found along streams and lakes and within meadows and wet areas shall be retained and protected insofar as practical.

3.9 Protection of Wildlife Habitat: Trees should be retained on areas designated as deer migration corridors, holding areas, or key ranges when consistent with good forestry practices. Also trees within meadows, wet areas and other areas should be designated in order to retain these areas for wildlife. These areas are to be shown on the Timber Harvesting Plan.

Live trees as designated with visible evidence of use as nesting sites by endangered bird species will be left standing and unharmed.

Live trees with visible evidence of use as nest sites by eagles or ospreys as designated by the Department of Wildlife are urged to be retained. These trees may be felled only during the time of year when such nest sites are not being used for breeding or other purposes. This period is normally from August 15th to February 1st.

3.10 Emergency Salvage Cutting: On timberlands which the State Forester has determined to have been substantially damaged by fire, insects, disease, wind, flood, air pollution, or substantial damage caused by an Act of God, the timber operator may remove all dead and dying, insect-infested and diseased timber, and other timber on the area so damaged after a harvest plan has been submitted and approved by the State Forester or his designee.

3.11 Exceptions: The requirements of this Article shall not prohibit the timber operator from cutting or removing trees for purposes of clearing the right-of-way, log landings, campsites, or firebreaks necessary for the conduct of timber operations. The harvesting of Christmas trees and construction of an integral part of a public fire protection agency fuelbreak are also permitted.

ARTICLE 4. LOGGING PRACTICES

4.0 Logging Practices: Every timber operator shall exercise due diligence in the management and operation of felling, yarding, and loading of timber or any activity connected therewith, to prevent unnecessary damage to residual trees, reproduction, riparian vegetation, and water quality, and to maintain the productivity of the forest land.

4.1 Felling Practices: Timber felling shall be done in such a manner as to protect the residual trees, reproduction, riparian vegetation, and trees left for wildlife benefits from unnecessary damage, and to minimize breakage in merchantable timber, insofar as topography, safety consideration, lean of trees, obstructions, openings and land locations permit.

4.2 Stump Height: Stumps shall be kept to a height of twelve inches or less on the side adjacent to the highest ground level, except where safety, imbedded metal, or unmerchantable wood make this impractical.

4.3 Landings: "Landings" shall be kept to a minimum size and number consistent with safe and efficient logging operations. Landings shall be no larger than one-half acre in size unless the reason for a larger size is explained in the Timber Harvesting Plan. Landings shall not be placed within a stream and lake protection zone or in meadows or wet areas unless specifically explained in the Timber Harvesting Plan, and approved by the variance committee as specified in N.R.S. 528.053.

4.4 Tractor Yarding: Every timber operator shall locate, construct and use tractor roads and skid trails so as to minimize damage to residual timber and reproduction. Skid trails shall be limited in number and width consistent with safe and efficient logging practice.

Tractor yarding equipment shall not be operated on known potential or active slide areas unless satisfactory protective measures are specified in the Timber Harvesting Plan.

Timber harvesting shall not be conducted under ground conditions which, due to excessive moisture, result in unreasonable soil compaction or accelerated erosion.

Tractor logging shall not be conducted on areas having average slopes in excess of (30%) unless a variance is obtained from the State Forester.

4.5 Cable Yarding: Cable lines shall be installed, hung, and operated so as to minimize damage to residual timber and reproduction.

4.6 Tight Lining: Tight-lining, when changing location of lines, is prohibited if such practice will damage or destroy residual trees or reproduction.

4.7 Rigging: Guy lines and other rigging shall not be hung on residual trees, unless said trees are protected from damage by effective protective devices.

4.8 Refuse, Litter, Trash, and Debris Disposal: In Special Treatment Areas, and within 200 feet of public roads, refuse, litter, trash, and debris, other than natural wood or vegetation resulting from timber operations in connection therewith, shall be disposed of concurrently with the conduct of timber operations, in accordance with State and local laws and regulations.

4.9 Servicing of Logging Equipment: Timber operations shall not operate or service any machinery or equipment in such a manner as to allow grease, oil, or fuel to pass into lakes or streams during or after operations.

ARTICLE 5. EROSION CONTROL

5.0 Erosion Control: Every timber operator shall conduct operations in such a manner as to protect soil resources from unnecessary damage and erosion. Tractor roads, skid trails, landings, logging roads and firebreaks shall be located, constructed and left after logging that water flow thereon and water flow in natural water courses shall not contribute to excessive erosion of soil. Following the use of tractor roads, skid trails, landings and temporary logging roads, and construction of firebreaks, and prior to the removal of logging equipment, waterbreaks shall be installed, natural water courses shall be opened where permanent culverts and bridges have not been constructed, and seeding or other practical measures shall be taken to meet the objective of preventing excessive soil erosion.

5.1 Waterbreaks: Waterbreaks shall be installed on all skid trails and landings as follows (See page H-12), based on slopes and erosion potential as stated in the Timber Harvesting Plan (See N.R.S. 528.0551).

TABLE H-2

MAXIMUM DISTANCE BETWEEN WATERBREAKS IN FEET
(SEE NRS 528.0551)

EROSION POTENTIAL	Land Slope Percent			
	10 or less	11 - 25	26 - 50	Over 50
Low	300	200	150	100
Medium	200	150	100	75
High	150	100	75	50
Extreme	100	75	50	25

The foregoing erosion control measures shall be completed on the following schedule:

(a) Within 30 Days, but not later than September 30th, after completion of seasonal or final use of tractor roads, skid trails, landings, and temporary logging roads when such use is concluded before September 30th of the current year.

(b) Concurrently with final or seasonal use of tractor roads, skid trail landings and temporary logging roads when such use occurs after September 30 of the current year.

(c) Concurrently with construction of firebreaks.

Waterbreaks shall be cut into the firm roadbed, skid trail or firebreak surface and shall provide for unrestricted discharge at the lower end of the waterbreak so that water is discharged and spread onto the adjacent area. Logging roads may be similarly drained by rolling dips.

(d) Revegetation work should not be done on areas where natural reproduction of native species will effectively bind the soil. Grass seeding must be supplemental to other soil stabilization measures such as mulching, pitting, scarification, water bars, or dips and cross ditching. Grazing must be excluded from areas where erosion control work has been performed until the vegetation is established.

5.2 Logging Roads: Roads shall be constructed and maintained in accordance with the following:

(a) Logging roads shall be located and constructed to utilize to the fullest extent practicable the general contours of the land in order to avoid excessive cuts, fills and road grades. Unless indicated in the Timber Harvesting Plan, roads shall be constructed to single lane width with turnouts at reasonable intervals. Both roads and turnouts shall be no wider than necessary to permit safe passage of logging trucks and equipment. Logging roads shall not exceed a grade of 15%, except that pitches of up to 20% will be allowed, not to exceed 500 continuous feet in length. These percentages and distances may be exceeded only where there is not other feasible access for the harvesting of timber, or the use of gradient in excess of 20% will serve to reduce soil disturbance. Said road will be indicated in the Timber Harvesting Plan.

The degree of gradient to which a particular road may be safely built from a watershed management standpoint varies with local conditions. The critical gradient is that grade beyond which it is uneconomical to provide for the a stabilized road prism and adjacent water disposal areas. The critical gradient is affected by rainfall intensity pattern of precipitation, soil types, ground cover on intercepting surfaces, class of road use, and plans and facilities for maintenance. In all cases, special drainage provisions will be made on logging roads regardless of gradient.

Minimum drainage will be required on those of little gradient and maximum protection given those of steeper gradient, taking into full account those factors affecting the critical grade.

(b) Logging roads shall be constructed with no overhanging banks.

(c) Any tree with more than 40 percent of its root system exposed by reason of road construction shall be felled.

(d) All permanent drainage ditches, rolling dips, culverts or other facilities needed to control erosion shall be installed concurrently with construction of the road.

(e) Road construction should avoid soil with highly erodible characteristics. Roads will be located where soils can be stabilized.

(f) All permanent structures shall be shown on the map accompanying the Timber Harvesting Plan. In bridge location, plan to avoid relocation of the stream channel. Where the stream must be changed, use rip rap to reduce soil movement into streams.

(g) Any side cast materials from road construction which has unimpaired access to a stream or lake shall be treated or intercepted to prevent it from entering the stream or lake.

(h) Culvert outflow shall not be discharged on erodible fill material unless rocks, downspouts or other suitable structures are placed so that the water velocity will be dissipated to minimize erosion. Culverts should be of adequate size and properly installed with a suitable bed and grade in the drainage channels. Avoid changes or disturbance of stream channels as much as possible.

(i) Berms shall be removed from logging roads except on fills and where necessary to deflect water to the drainage facility upon completion of logging or before September 30th of the current year so that water may freely flow off the road surface.

(j) No significant amount of woody material shall be incorporated into fills.

(k) During timber operations, road running surface in the logging area shall be maintained to prevent excessive loss of road surface material.

(l) Cross-Ditches: (Rolling dips). Cross-ditches (See Figure H-2, page H-16) are used to supplement outsloping and built-in drainages such as culverts, grade breaks, and dips. They should be constructed in such a manner that a vehicle will roll rather than bounce over them. Guides for cross-ditch construction:

1. Slope diagonally out and downgrade at a minimum angle of 60 degrees with the center line of the road. The ditch should be tied securely to the upper bank.

(See Figure H-2, page H-16)

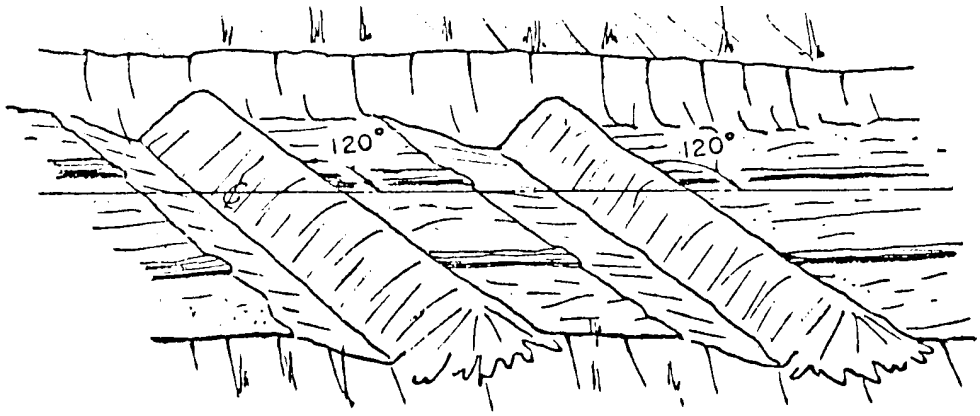
2. The ditch is bulldozed or cut with a grade blade into the roadbed to a depth of at least 12 inches on the road shoulder.

(See Figure H-3, page H-17)

3. Excavated material should be scattered below the ditch so that no dike or barrier is noticeable.

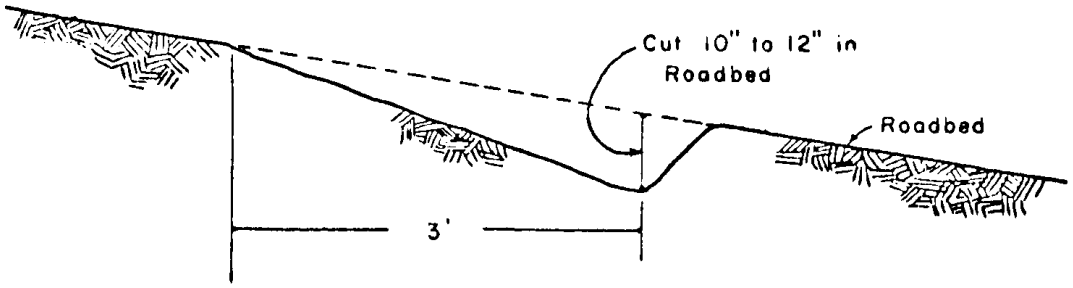
4. Handwork is required to open the ditch and to secure the needed outsloping.

FIGURE H-2 (FIGH1.PCX)
VIEW OF COMPLETED CROSS-DITCH



View of Completed Cross-Ditch

FIGURE H-3 (FIGH2.PCX)
CROSS SECTION OF CROSS-DITCH



CROSS SECTION
OF CROSS-DITCH

(m) Location of Cross-ditches. Cross-ditch locations will be flagged or staked in advance of construction of ditches. This will be done by the timber operator in charge of the sale or by other qualified persons.

1. Locate the cross-ditch to take advantage of dips, changes in grade and natural barriers wherever possible.

2. Ditches should be located directly below water courses, draws, intercepting skid trails and roads, below outcurves and above incurves.

3. Locate so that outlet does not discharge onto long, loose fills. Discharge on rocks, accumulation of wood, on flats and on other places where water can be spread rather than concentrated.

4. Place cross-ditches on each end of all fill sections.

5. The spacing of surface drainage structures will vary with soil type, with grade, and width of road. Maximum spacing of cross-ditches is as follows:

Spacing in feet for relative Erosion Hazard is depicted in Figure H-4 (page H-19).

FIGURE H-4

SPACING IN FEET FOR RELATIVE EROSION HAZARD

Road Gradient (percent)	Extreme	High	Moderate	Low
5 or less	100	240	480	720
5 to 9	75	170	340	520
10 to 15	50	100	200	500

ARTICLE 6. STREAM AND LAKE PROTECTION
(Refer to: N.R.S. 528.053)

6.0 Stream and Lake Protection: The purpose of this Article is to insure the protection of beneficial uses that are derived from the physical form, water quality, and biological capacity of streams and lakes.

It is the further purpose of this Article to minimize erosion of stream and lake banks and beds during the conduct of timber operations.

In order to prevent unreasonable adverse effects on the beneficial uses of streams and lakes, each timber operator shall do the following:

(a) Below the stream and lake transition line, the streams will be kept free of slash, debris, side cast and other materials from logging operations. Accidental deposits shall be removed as soon as practicable. Trees cut within 50 feet of the surface of the ground shall be felled as nearly as possible at right angles away from the stream or lake, or in such a manner as to minimize erosion and maintain water quality.

(b) The timber operator shall prevent the discharge of soil, silt, bark, slash or other organic and earthen material from any logging, construction or associated activity into any stream or lake in quantities deleterious to fish, wildlife or other beneficial uses of water.

(c) When logging skid trails must cross a live stream, a prepared crossing shall be used.

(d) The timber operator shall not use beds of streams as landings, roads, or skid trails, except at prepared crossings.

(e) At all road crossings of live streams, install suitable structures of sufficient size to allow for the full surface flow of the stream throughout the entire period of timber operations. All structures shall be placed to allow unrestricted fish passage.

(f) All temporary stream crossing structures not designed for the normal maximum flow of the stream shall be removed prior to the normal maximum flow of the stream. All temporary structures shall be removed upon completion of logging.

6.1 Protection of Water Quality and Wildlife Habitat: To minimize erosion and protect water quality and fish and wildlife habitat within the stream and lake protection zone, adjacent to perennial streams and lakes, riparian vegetation, residual timber and other soil-protecting and shade producing vegetation will be protected from unnecessary damage.

Felled trees shall be end-lined to the edge of the stream and lake protection zone and tractors on skidding equipment will not be operated within the zone except on existing roads of where less damage will result from the use of such equipment.

Within the stream and lake protection zone, enough trees or shrubs of any species shall be left so that 50% or more of the shade-producing canopy before timber operations shall remain after timber operations are completed. When explained and justified, the Timber Harvesting Plan may provide for a lesser percentage of remaining shade-producing canopy where it is necessary to achieve stocking standards or if it can reasonably be expected there will not be substantial adverse effects on soil erosion, wildlife, aquatic life, or unreasonable effects on the beneficial uses of water because of one or more of the following reasons:

(a) The remaining canopy or streamside shrubs will still provide adequate protection;

(b) A stream is oriented with a northerly or easterly facing slope such that the aspect substantially reduces the amount of solar radiation;

(c) The depth and narrowness of the canyon at stream level is such that removal of additional percentage of canopy does not adversely affect the water or substantially increase erosion;

(d) The combination of inherent temperature, depth, rate of flow and volume of water is such as to prevent significant heating or temperatures higher than normally required for the survival of fish;

(e) The length of stream affected by canopy decreased is less than 200 feet.

Only sanitation salvage cutting may be done in future harvests within the stream and lake protection zone until such time that the canopy has become sufficiently reestablished to prevent substantial adverse effects on soil erosion, wildlife, aquatic life, or the beneficial use of water.

In the event the State Forester disagrees with the judgement exercised by the timber landowner or his designated representative and the plan is rejected following an on-the-ground inspection which may be requested by either party, the person who submitted the plan may appeal to the Board of Forestry.

6.2 Soil Treatment - Stream and Lake Protection Zone: Areas exceeding 800 square feet in size within the stream and lake protection zone, where bare mineral soil is exposed by timber operations and pose a threat to a stream or lake, shall be treated to keep the soil from entering the stream or lake, shall be treated to keep the soil from entering the stream or lake.

Treatment shall be done prior to October 15th, except that such bare areas created after October 15th shall be so treated within ten days.

ARTICLE 7. HAZARD REDUCTION

7.0 Hazard Reduction: The purposes of this Article are to provide for the treatment of snags, logging slash and other debris in the logging area in order to reduce the fire hazard associated with timber operations, to protect the timber resources from wildfire and potential insect and disease attack, and to prepare the area for natural or artificial reforestation.

7.1 Snag Disposal: All snags over 20 feet in height within the logging area shall be felled concurrently with the timber operations, except as provided below:

(a) In the salvage of fire-killed timber, the operator shall only be required to fell such snags within 200 feet of the edge of the traveled surface of all roads which traverse the burned area and within 200 feet of places of habitation and within a strip 200 feet wide whose exterior boundary is the perimeter of the burn, such distances to be measured along the surface of the ground.

(b) Due consideration should be given to leaving snags less than 50 feet in height which exhibit wildlife values and/or exhibit visible evidence of use as nesting sites by eagles, hawks, owls, waterfowl, or any rare or endangered species. Other specifications may be required in the forest harvest plan that are site specific.

(c) Exception to height and location may be made for the protection of wildlife for specific snags showing evidence of active wildlife use not to exceed one snag per 20 acres of timber operating area when designated in writing and marked for leave by the authorized representative of the timberland owner and the State Forester.

The above provisions in no way shall exempt any person from federal and state safety laws and regulations that require the felling of snags.

7.2 Treatment of Logging Slash: Limbs shall be lopped from the unutilized portions of felled trees and all trees felled or pushed over in road construction. Lopping shall be done concurrently with the timber operation.

7.3 Slash Disposal Within Fire Protection Zones: All slash created by road construction or timber operations, including trees knocked down, within the fire protection zone shall be treated by lopping and scattering so that generally none will be more than twenty-four (24) inches above the ground or by piling and burning, chipping, burying, or by removal from the zone.

7.4 Piling and Burning: As an alternative to lopping, the operator may pile and burn the slash and other logging debris. Such piling and burning shall be done in the following manner:

(a) Slash and debris shall be piled and burned in a location and manner which will not excessively damage the residual trees or reproduction.

(b) Piles shall be sufficiently free of earth and other non-combustible material for effective burning. Piles shall be hand piled or pushed into a pile with equipment that has a brush rake attachment.

(c) The piled slash shall be burned at a safe time during the first wet fall or winter weather, or other safe period following piling and according to laws and regulations. Piles that fail to burn clean shall be further treated for disposal. All reasonable precautions shall be taken to confine such burning to the piled slash.

(d) Piles shall not be burned within 50' of a stream as defined by N.R.S. 528.0255.

7.5 Broadcast Burning: Slash may be broadcast burned. No broadcast burning shall be permitted within the stream and lake protection zone. The local representative of the State Forester shall be notified in advance of the time and place of burning and all burning shall be done in a manner provided by law.

ARTICLE 8. FIRE PROTECTION

8.0 Fire Protection: When burning permits are required by the State Forester, every timber operator shall have a fire protection plan and program for prevention and suppression of fires in his logging areas.

8.1 Fire Plan Filing: Every timber operator shall prepare in writing a fire prevention and control plan. He shall file a copy of such a plan with the State Forester by no later than April 1st of each year, or if his operations commence for that year later than April 1st, then the plan shall be submitted not later than ten (10) days prior to the date of the beginning of such operations. Such filing to be made to the nearest headquarter's office of the Nevada Division of Forestry as follows:

OFFICE LOCATION	FIRE PLAN FOR:
Western Area 885 Eastlake Boulevard Carson City, Nevada 89710 (702) 849-2500	Washoe, Pershing, Lyon Churchill, Mineral, Douglas, Carson City Storey Counties

Northern Area P.O. Box 1507 Elko, Nevada 89801	Elko, White Pine Eureka, Lander Humboldt Counties
(702) 738-3454	
Southern Area 4747 West Vegas Drive Las Vegas, Nevada 89158	Esmeralda, Nye, Lincoln, Clark Counties
(702) 486-5123	

8.2 Fire Plan Contents: Timber operators' written fire prevention and fire control plan shall include, but not limited to, the following information:

(a) The name, address and 24 hour telephone number so a responsible person and an alternate who have authority to act for the operator in fire suppression operations.

(b) Location and number of men available for fire fighting duties.

(c) Kind, type and location of tools and equipment, including bulldozers, and water tank trucks suitable for fire fighting purposes.

(d) The plan shall set forth the general procedure which will be followed for the detection, control, and suppression of uncontrolled fires.

(e) Sketch map and land subdivision description of logging areas upon which timber operations may currently be conducted or are anticipated of being conducted during the ensuing forest fire season.

8.3 Roads to be Kept Passable: Timber operators shall keep all logging truck roads in a passable condition during the dry season for fire truck travel until snag and slash disposal has been completed.

8.4 Smoking and Matches: Timber operators shall make and enforce rules prohibiting persons employed, or otherwise engaged by them in timber operations, from smoking on timberland belonging to, or under the control of, the timber operator; with the following exceptions subject to any law or ordinance prohibiting, or otherwise regulating smoking, such rules may allow smoking when persons engaged in such operations are not moving about and are confined to cleared landings and areas of bare soil at least three feet in diameter. Burning materials shall be extinguished in such areas of bare soil before discarding.

8.5 Lunch and Warming Fires: Timber operators shall make and enforce rules for setting, maintenance, or use of warming or other fires used for the comfort or convenience of employees or other persons engaged in timber operations. Rules and rule enforcement for fires shall be subject to terms of written permission from the land owner and to any law or ordinance regulating or prohibiting fires. The rules made by the timber operator shall require clearance of ten feet or more from the perimeter of such fires of flammable vegetation or other substances conducive to the spread of fire. Rules shall require warming fires to be in a depression in the soil to hold the ash created by such fires. Timber operators shall not allow such fires to be left unattended unless totally extinguished and the fire site covered with soil.

8.6 Posting Fire Rules: Timber operators shall post notices which set forth the fire prevention rules they have prescribed in connection with their timber operations and such notices shall be posted in sufficient quantity and location throughout their logging areas so that all employees or other persons engaged by them to work therein shall be informed of such rules; and timber operators shall provide for diligent supervision and enforcement of fire prevention rules throughout their operations.

8.7 Blasting and Welding: Timber operators shall provide for a diligent fire watchman service at the scene of any blasting or welding operations conducted on tier logging areas to prevent and extinguish fires resulting from such operations. Blasting and welding permits must be obtained before such activity commences.

8.8 Inspection for Fire: Timber operators shall daily provide diligent inspection to detect and report fires in all parts of their logging areas where men or equipment have been working. Inspection shall be made no sooner than one hour after such operations have ceased for the day.

8.9 Cable Blocks: During the declared fire season, all tail and side blocks on a cable shall have a cleared area to mineral soil at least 15 feet in diameter. A shovel and an operational full five-gallon back pump must be located within 25 feet of such block prior to yarding.

8.10 Glass Container: Timber operators shall prohibit the use of uncovered glass containers on their logging areas.

ARTICLE 9. FOREST INSECT AND DISEASE PROTECTION PRACTICES

9.0 Insects and Diseases: Every timber operator shall provide reasonable protection against forest insects and diseases.

9.1 Prevention Practices: Timber operations shall be conducted in a manner that will minimize the build-up of destructive insect population or the spread of insect disease.

9.2 Locating and Reporting: Timber operators and timber owners shall assist the State in determining the location of insect and disease outbreaks, and report such outbreaks to the state Forester or his representative.

ARTICLE 10. INFRACTIONS OF RULES PRIOR TO CHANGES

10.0 Infractions of Rules Prior to Changes: Amendment, modification or repeal of rules shall not, unless otherwise provided, bar action on prior infractions of rules as they stood at the time of infraction.

Appendix H-2

WILDLAND/URBAN INTERFACE MANAGEMENT

The wildland/urban interface is the area where urban development, typically residential homes, meets the wildland or native vegetation. This area is characterized by heavy vegetation (i.e., shrubs, and trees) surrounding structures, with limited access. The populations desire to "live in the country", particularly in the western states, has resulted in extensive development in wildland areas previously unoccupied. Additionally, some areas of the west have incorporated extensive amounts of landscaping and adapted plant materials into their communities, so that they have in effect, created a wildland/urban interface. During the hot summer months and periods of drought the vegetation dries out becomes a major fuel source.

A significant conflict for fire management agencies occurs when fire suppression efforts are directed to the protection of structures at the expense of natural resources. Vast acerages of high value watershed has been destroyed resulting in extensive erosion and sedimentation, a loss of wildlife habitat and forage resources and impacted the economic health of many communities.

Development in the wildland/urban interface has inevitably increased the risk of fire as only in recent years has planning for fire protection been incorporated into the development review process. Nevada has been somewhat of a leader in wildland/interface management through the development of the Sierra Front Wildfire Cooperators. Extensive development along the eastern front foothills of the Sierra Nevada range and in the Mt. Charleston area of southern Nevada, Coupled with several major wildfires during the 1980's, resulted in a cooperative effort between fire and land management agencies at the local, state and federal level. Significant accomplishments have been made in the areas of building material controls, land use controls, access, communications, fire suppression resources, fuels management and pre-incident planning.

The following management tools are general but should guide local communities, real estate developers and individual homeowners in developing mechanisms for the management of the wildland/urban interface.

* **Prevention:** Prevention is the primary first line of defense against wildfire. A prevented fire requires no suppression and results in no damage. The three primary prevention categories are:

  Education Programs - To motivate and educate people to be fire safe through the media, schools, special events and signing.

Regulations - The development of federal, state and local ordinances and laws to manage peoples activities and actions. Regulations could include land use controls, access controls, burning laws, and building codes.

Law Enforcement - Fire laws must be enforced to be effective. Enforcement activities should be coordinated at the federal, state and local levels.

* **Presuppression:** While prevention efforts attempt to address human caused wildfire ignitions, mother nature cannot be totally predicted or controlled. Because lightning caused wildfires are unavoidable, and highly flammable fuels (vegetation) continue to grow annually, presuppression activities are needed to reduce the wildfire hazard.

Pre-planning - Formulate a team of all the affected persons, agencies and governmental entities (i.e. fire departments, land managers, local governments, property owners, etc.). **A qualified professional should identify high fire hazard areas utilizing industry standards (i.e. topography, vegetation, access, exposure, weather patterns, etc.).** Identified high fire hazard areas should then be mapped and incorporated into the county/community development review process. High fire hazard areas are then analyzed for key issues which include:

Existing Vegetation (Fuels);
Existing and Proposed Land Uses;
Access;
Topography;
Utility Infrastructure - Water, Electrical, etc.;
Fire Suppression Resources;
Existing Structures - Type and Construction Materials;
Existing Land Use, Zoning and Planning Ordinances; and
Building Codes and Construction Material Regulations.

Every site is unique and as such, may require that additional issues and/or conditions be assessed. The gathered information is then utilized to develop a comprehensive wildland/urban interface management plan. The plan should address the primary issues and identify management options and/or solutions for each high fire hazard area. Modification of existing regulations or the development of new regulations should be fully explored. It is very important that the public is involved and commits to the management plan. A public commitment will ensure a workable plan.

Fuels Management - Fuels management, (See Appendix H-3, "Fuels Management Guidelines") involves the reduction in fuels density or the conversion of a vegetation type to a more fire retardant type. Fuelbreaks are the commonest form of fuels management and typically consist of a linear strip where existing vegetation is removed and replanted with fire resistant grass species. Fuelbreaks should be incorporated into identified high fire hazard areas and illustrated on project mapping within the plan. Fuelbreaks are strategically located and are easily accessible by fire suppression equipment. Fuelbreaks serve as a line of defense during a wildfire and are proven to save structures, human lives and in reducing suppression costs. All fuels management techniques require maintenance to maintain their effectiveness.

Planning and Development Regulations - Development within the wildland/urban interface is very popular and is here to stay. The key to safety is to design and construct wildland/urban interface developments in a manner which minimizes the risk of wildfire. This requires the development of specific development regulations for high fire areas which address the issues identified in the pre-planning section. Numerous states and communities throughout the west have completed comprehensive development regulations for the wildland/urban interface. This information is available through the Nevada Division of Forestry, State Foresters Office.

Implementation - The final step in the wildland/urban interface management planning process is implementation. The plan should be presented through the media, at all levels, to all age groups. Annual review of the plan is a key component, which should include public involvement. At the beginning of every fire season, special effort should be made to re-educate the public on all aspects of wildfire prevention and presuppression.

* **Suppression:** Wildland fire suppression activities are handled by professionals who are extensively trained in fire science. From a home owners stand point it is best to leave the fire fighting to the professionals and not unnecessarily risk human lives.

A properly designed, implemented and maintained wildland/urban interface plan, whether at an individual property owner level or at the community level will greatly reduce the devastating effects of wildland fire. Additional information is available at your local fire department or the Nevada Division of Forestry.

Appendix H-3

FUELS MANAGEMENT GUIDELINES

GENERAL

Fuels management has become an important component for the wildland/urban interface dweller. Fuels management is defined as reducing the fuel density and/or the replacement of a vegetation type with a more fire resistant type. For the wildland/urban interface dweller fuels management is critical to maintaining the surrounding vegetation to minimize the threat of wildland fire. The application and maintenance of proper fuels management techniques greatly improves the ability of fire fighters to control a wildfire and protect a structure, slows the spread of wildfire and may result in improved wildlife habitat. A reduction in wildfires and the corresponding natural resource damage (watershed values, wildlife, etc.) will equate to reduced sedimentation and erosion.

Fuels management must be tailored to the specifics of the site and can vary significantly in magnitude as well as methodologies. Mechanical, chemical and biological procedures and controlled burning are used singularly or in combinations depending upon many factors, including:

(1) Type Of Land Use (Site);
(2) Topography and Elevation;
(3) Species of Plants - Whether They Are Root-sprouters or Non-sprouters;
(4) Size, Abundance and Distribution Of Woody Plants;
(5) Hazards Of Treatment, If Any;
(6) Objectives Of The Land User;
(7) Costs In Relation To Expected Benefits; and
(8) Access.

The objectives, methodologies and maintenance of a fuels management project should be developed and incorporated into a comprehensive fuels management plan. Fuels management requires ongoing maintenance to be effective. **The assistance of qualified professionals should be obtained in developing a fuels management plan.**

Non-chemical methods of fuels management should be used whenever feasible and where land disturbance and resulting sediment delivery can be minimized. Phenological development of the plants being controlled and of the plants being favored is of prime importance. Select the time when plants to be controlled are most vulnerable to the specific treatment. For growth regulating chemicals, this is a time of most active growth. Mechanical treatment is most successful just prior to seed maturity when root reserves are lowest.

Techniques Associated with Fuels Management

1. Defer grazing prior to fuels management activities that are designed to improve the resident forage species.

2. Tailor grazing management to favor the key species following fuels management. Grazing can be utilized as a fuels management tool.

3. Leave sufficient herbaceous plants, shrubs and trees to maintain desirable wildlife habitat, migration and escape routes. Surface stability should not be jeopardized by removing too many herbaceous or woody plants.

4. Provide for preservation of natural beauty to the fullest extent possible. This could include strategically located and irregularly shaped patches, usually in a contiguous manner. Avoid square patterns.

5. Incorporate fuel breaks into existing topographical and physical features such as roadways, stream zones or meadows.

6. Elimination of "ladder" fuels to prevent the growth of a ground fire to a crown fire.

7. Reseeding with fire resistant plant species.

METHODS AND MATERIALS

1. Mechanical

    a. Plowing

        (1) Adaptation: Low shrubs on sites planned for seeding.

        (2) Equipment: Disk or moldboard plow; heavy offset disk, root plow.

        (3) Dates: Late spring to early fall before shrubs have matured seed. Soil should be dry enough to prevent regrowth of partly covered plants.

        (4) Operation: Plow below root crown. Operate disk at sharp angle. Repeat at later date if necessary for satisfactory kill.

b. Chaining

(1) Adaptation: Pinyon, juniper, or sagebrush stands that are predominantly mature and brittle. Less effective on young, limber plants or those that resprout. Adapted to sites that will be seeded or for improvement of native range with less than a full stand of forage plants.

(2) Equipment: A 70 to 90 pound anchor chain, modified by welding rails to each link and installing swivels on each end.

(3) Dates: Same as for plowing.

(4) Operation: Pulled between two tractors, twice over in opposite or diagonal directions. May be broadcast or drill seeded between operations.

c. Beating/Cutting

(1) Adaptation: Stone-free sites with low shrubs that do not readily resprout. Not adapted to rabbitbrush, snowberry, silver sagebrush, three-tip sagebrush or Anderson peachbrush. Adapted to sites that will be seeded or managed for natural improvement.

(2) Equipment: Flair beaters or circular cutters.

(3) Dates: Same as for plowing.

(4) Operation: Cut as near ground level as possible. Adjust travel speed to brush conditions.

d. Controlled Burning

(1) Adaptation: Big sagebrush or other non-sprouting brush or trees on sites planned for seeding. Heavy stands of non-sprouting shrubs or trees with good understory of desirable forage plants.

(2) Equipment: Farming or earthshaping machinery to prepare firebreaks; flamethrowers or weedburners.

(3) Dates: Brush should be burned in mid or late summer after understory is dry but before brush seed has been dispersed. Grass root reserves should be high after seed maturity. Cheatgrass should be burned in late spring just prior to seed maturity. It is necessary to obtain the required burning permits.

(4) Seeding: Seed burned areas as soon as possible after burning.

e. Thinning

(1) **Design and develop a timber harvest plan utilizing a qualified professional and coordinated with the appropriate federal, state and local agencies.**

(2) Equipment: Logging equipment, (i.e., yarders, skidders, chain saws, etc.) helicopters, trucks and chippers.

(3) Dates: Timber harvesting or thinning operations typically occur during the spring, summer and fall months depending upon elevation, topography, snow, soil moisture, and other specifics of the site.

(4) Seeding: Surface disturbances associated with timber harvesting should be graded and revegetated immediately upon completion of the activity.

f. Chemical

(1) Use only approved chemicals, Follow agency recommendations for materials, rates and application procedures.

(2) Apply in accordance with pesticide labeled use registered with the Nevada Division of Agriculture. Always read the label on the pesticide container before using the material.

(3) If herbicides are handled or applied improperly, or if unused portions are not disposed of safely, they may injure humans, domestic animals, desirable plants, and fish or other wildlife, and may contaminate nearby crops, other vegetation and the watershed. Follow the directions and heed all precautions on the container label. Herbicides should not be used over or directly adjacent to ponds, lakes, or streams.

g. Maintenance

(1) An ongoing maintenance plan should be developed inconjunction with the fuels management plan. Maintenance activities should be implemented on an annual basis to maintain the effectiveness of the shrub and tree treatments.

(2) Equipment: Typically annual maintenance will require hand labor involving pruning, trimming, and general clean up.

(3) Dates: Maintenance activities typically occur during the spring and fall, before or after the fire season.

APPENDIX I - URBAN RESOURCE MANAGEMENT

Appendix I-1

LANDSCAPING IN THE GREAT BASIN

Landscaping residential, commercial or industrial areas in the Great Basin environment is quite different than many areas of the west which benefit from higher amounts of precipitation. Nevada's annual precipitation varies from as low as four inches in the south to approximately twenty inches in the northeast. Western Nevada is subject to a rain shadow effect from the Sierra Nevada Range which greatly reduces our annual precipitation compared to the western slope of the Sierras. The wise use of water in landscaping is critical given our limited supplies, growing population and periods of drought. The following basic principals of landscape design and irrigation management will ensure Great Basin residents of an aesthetically pleasing landscape while getting the most benefit from existing water supplies.

PLANNING

The first step in designing and developing a landscape is to plan. The goals of the landscape should be clearly defined. For example are large turf areas needed for outdoor play or is the purpose of the landscape to screen an industrial site. After determining the landscape goals a design should be developed on paper which is drawn to scale accurately. The design should clearly illustrate the topography of the site, structures, walkways and driveways, the water source, elevation, north arrow and any other features or unique conditions of the site. All impervious surfaces should be clearly illustrated and the soils of the site should be tested for fertility. The actual landscape design can then be based upon this information. **The assistance of a qualified professional may be necessary given the specifics of the site.**

PLANT MATERIAL SELECTION

In conjunction with the design phase the selection of plant materials which are native or adapted to the Great Basin environment and to the goals of the landscape is important. The wise use of water resources hinges on the plant materials selected. Plant materials should be selected upon the following criteria.

* Topography and Soils;
* Climatic Conditions - Wind, Temperature and Exposure;
* Elevation;
* Mature Height, Spread and Water Requirements;
* Growth Characteristics - Flower, Fruit, Shape and Growth Rate;
* Texture and Color;

Over planting is one of the single most common mistakes made in developing a landscape. The landscape should be designed for plant material maturity with room for plant materials to grow. Overcrowding results in plant mortality, wasted water and an unhealthy landscape.

Turf grasses are one of the most important components of the landscape and one of the most misused plant materials. Turf grasses should be selected for their intended use and not over planted. The benefits of turf grass are numerous including erosion control, ground water recharge, lowering of surface temperatures and reduced surface water runoff. Selecting the appropriate turf grass for the area does not require large amounts of irrigation water or fertilizer. A significant amount of maintenance may be necessary for turf grass depending upon the site. Turf grass areas require separate irrigation from trees and shrubs.

IRRIGATION

An appropriately designed irrigation system will meet the needs of the selected plant materials without overwatering. Turf areas should be designed to minimize over spraying of impervious surfaces, trees and shrubs. To avoid overwatering, turf grasses should be irrigated in zones utilizing spray sprinklers. Trees, shrubs and flowers should be irrigated with a drip system and micro-sprays. Each zone of the irrigation system should be independently controlled via an automated controller. This flexibility will ensure a healthy landscape without waste of irrigation water. As Great Basin winters almost always include freezing temperatures for extended periods of time, the irrigation system should be installed with automatic drains in the distribution lines and manual drains at the valves and backflow preventer. Every irrigation system should include a backflow prevention device to insure that the drinking water supply is not contaminated.

MULCHES

The used of both organic and inorganic mulches is one the best methods of conserving water and creating microclimates conducive to plant growth. Organic mulches include: bark, compost, sawdust, leaves and grass clippings. Organic mulches should be placed in planting beds and around plant materials. Inorganic mulches include rock, crushed stone and gravel. Storage areas, foot traffic areas and in areas where plants are not desired can all receive inorganic mulches. Weed control can be achieved by utilizing one of the many fabrics which allow water infiltration yet prevent weed growth.

MAINTENANCE

Maintenance of a landscape can be a full time job if the landscape is not properly designed. The selection of the appropriate plant materials and not over watering the landscape will greatly reduce maintenance requirements. Regular inspections of the irrigation system including the spray sprinklers and the drip emitters will also minimize maintenance and plant material loss. Fertilizing turf grasses in only the spring and fall will ensure a health lawn with minimal thatch build up.

Appendix I-2

WELLHEAD PROTECTION GUIDELINES

As mandated by the 1986 Amendments to the Safe Drinking Water Act (SDWA) the Nevada Division of Environmental Protection, Bureau of Water Quality Planning (NDEP-BWQP) has developed a Wellhead Protection Program (WHP) for Nevada. The program is contained in the document "State of Nevada Wellhead Protection Program", dated December 1993 and is available to the public at NDEP-BWQP offices in Carson City, Nevada. Primary components of Nevada's Wellhead Protection Program (NWHPP) are summarized in the following discussion.

The primary goal of WHP in Nevada is the protection of public drinking water supplies through the implementation of contaminant source controls at the community level. To achieve the State's goal the NWHPP has been developed and implemented at both the State and local level. Present activities at the state level are designed to achieve the following objectives.

* Generate Interest and Participation in WHP Activities Through Public Outreach and Education;

* Place Responsibility For WHP on at the Local Level;

* Develop Program Guidelines Which Will Facilitate Community Involvement in all Aspects of Wellhead Protection; and

* Provide Technical Assistance as Requested.

WHP programs must be developed and administered by those governments having jurisdiction (i.e., county commission, city council, town board) in conjunction with the public water suppliers (public or private entities). WHP in Nevada is voluntary and the NWHPP allows for flexibility in developing WHP activities. This is important given the vary diverse urban and rural communities within the State.

A complete WHP program which is endorsed by the State and the U.S. Environmental Protection Agency (EPA) will include the following seven core elements:

* Roles and responsibilities of the state agencies, local governments, and the water supply providers;

* Delineation of WHP areas;

* Contaminant source inventories;

* WHP area management options;

* Siting of new wells;

* Contingency planning; and

* Public participation.

While the NWHPP is non-regulatory, the State will encourage and assist those communities which commit to the development and implementation of a complete WHP program. Both technical and financial assistance will be prioritized and provided based upon the commitment of the community to a complete WHP program. Of the seven program elements, the delineation of WHP areas, the identification of existing and/or potential contaminant sources and the development of wellhead protection area management options are the most important to the communities.

Delineation of Wellhead Protection Areas (WHPAs): A WHPA is defined as the surface and subsurface area surrounding a water well or well field which supplies a public or private water system through which contaminants are reasonably likely to move toward and reach such water well or well field. There are numerous methodologies utilized for the delineation of WHPAs which are selected based upon the specifics of the site and available data.

NDEP-BWQP is developing a guidance document to assist local governments and public water suppliers in their delineation efforts. It is also important to note that in Nevada the recharge area for many water supply wells may be some distance away or include a very large area. This may pose some difficulty in coordination between landowners and land managers and under scores the need for cooperative efforts at all levels of government.

Identification of Contaminant Sources: The inventorying of existing and/or potential contaminant sources within the delineated WHPA is critical to the effectiveness of the WHP program. The inventory serves as the basis for development of management strategies. The state is also conducting a statewide inventory of contaminant sources which will be made available to communities for WHP activities.

Wellhead Protection Management Strategies: Typical management strategies include both regulatory and non-regulatory mechanisms. Land use controls, zoning/master plan ordinances and special use permits are some commonly used regulatory tools. Land purchases, acquisitions and donations are examples of non-regulatory tools.

WHP programs have been initiated in seven Nevada communities to date and interest is growing rapidly. WHP simply makes sense as the clean up of a contaminated water supply well can potentially be very expensive or not possible at all. The importance of maintaining a quality drinking water supply can not be over emphasized. Additional information on NWHPP is available from the NDEP-BWQP.